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CSM 104

CMP CHECKLIST

CMP CHECKLIST

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SECTION 1 - CMP Insertion Activities

1 Mount optics, MOUNT G+C HANDHOLDS

2 OPTICS DUST COVER JETT PROCEDURE

Install Eyepieces

OPTICS ZERO - OFF

G/N OPT PWR - ON (up)

OPT MODE - MAN

OPT COUPLING CONT - DIRECT

OPT SPEED CONT - HI

OHC - Max Right - Observe ejection thru eyepiece

3 P52 IMU REALIGN

B MAG MODE (3) - RATE 2

G/N PWR OPTICS - on (verify)

CMC MODE - FREE

OPT ZERO - ZERO (verify)

OPT MODE - CMC

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- 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 5
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 1dg site coords
PRO
- 4 F 06 22 NEW ICDU ANGLES OG, IG, MG (.01°)
(IF MG>70°, MNVR) V32E - to 4
PRO NO ATT lt - on then off
- 5 F 50 25 00015 STAR SELECT
(MNVR If Necessary)
(PICAPAR) PRO

| | | | | | | | | | | | |
|----|---------|-----------------------|----------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|--------------------------------------------|---------|-----------------------|---------------------------------------------------|----------------------------------------------------------------------|-----|
| 6 | F 01 70 | 000DE STAR CODE | Load desired code OPT MODE - CMC (verify) | PRO to 8 (to 7 if DE=00) | *F 05 09 00404 (TA>90°)* *OPT ZERO - OFF | *MNR 09 00404 (TA>90°)* *MNR - PRO To 8 | F 06 88 | CELESTIAL BODY VECTOR | Load desired vector PRO | *F 05 09 00404 (TA>90°)* *MNR - PRO To 8 | 8 |
| 7 | F 06 88 | CELESTIAL BODY VECTOR | Load desired vector PRO | *F 05 09 00404 (TA>90°)* *MNR 09 00404 (TA>90°)* | *MNR - PRO To 8 | *MNR 09 00404 (TA>90°)* *MNR - PRO To 8 | 8 | SHAF T, TRUN | *F 05 09 00404 (TA>50°)* *PROG ALARM (TA>50°)* | (MARK ROUTINE) OPTICS MODE - MAN | 9 |
| 8 | 06 92 | SHAF T, TRUN | *MNR - PRO To 8 | *F 05 09 00404 (TA>90°)* *MNR - PRO To 8 | *F 05 09 00404 (TA>90°)* *MNR 09 00404 (TA>90°)* | *MNR 09 00404 (TA>90°)* *KEY RLS E | 9 | F 51 | PLEASE MARK | (MARK ROUTINE) OPTICS MODE - MAN | 10 |
| 9 | F 50 25 | 00016 TERMINATE MARKS | PRO | *V5N9E 00407 | *V5N9E 00407 | *MNR 09 00407 | 10 | F 01 71 | 000DE STAR CODE | Load code (if necessary) PRO to 6 after 1st MARK (to 12 if DE=00) | 11 |
| 11 | F 01 71 | 000DE STAR CODE | to 13 after 2nd MARK (to 12 if DE=00) | | | | | | | | CSM |

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1-3/4

- 12 F 06 88 CELESTIAL BODY VECTOR
Load vector
PRO to 6 after 1st MARK
to 13 after 2nd MARK
- 13 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(REJECT) V32E to 15
(ACCEPT) PRO
- 14 F 06 93 TORQUING ANGLES OG, IG, MG (.001°)
(TORQUE) PRO (CMC - FREE)
(BYPASS) V32E
- 15 F 50 25 00014 ALIGNMENT CHECK
(RECHECK) PRO To 5
(BYPASS) ENTR
- 16 F 37 OPT ZERO - ZERO
XXE
- 4 Stow optics
- 5 Unstow:
a. Helmet bags from A-5, Pass to CDR/LMP
b. TSB A-5
c. Update books from R1,2,3
d. Aux straps from R-5
e. R-12 from R-3
f. Cameras
 Hass B-3
 Film B-3
 Seq B-3
 Lens B-3
 Film B-3
 Bracket R-10
 Spot meter B-3
6. EXTEND DOCK PROBE

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SECTION 2. REFERENCE DATA

STAR LIST

| <u>STAR NAME</u> (Numerical) | <u>STAR NAME</u> (Alphabetical) | |
|---------------------------------|------------------------------------|----|
| 00 Planet | Acamar | 6 |
| 1 Alpheratz | Achernar | 4 |
| 2 Diphda | Acrux | 25 |
| 3 Navi | Aldebaran | 11 |
| 4 Achernar | Alkaid | 27 |
| 5 Polaris | Alphard | 21 |
| 6 Acamar | Alphecca | 32 |
| 7 Menkar | Alpheratz | 1 |
| 10 Mirfak | Altair | 40 |
| 11 Aldebaran | Antares | 33 |
| 12 Rigel | Arcturus | 31 |
| 13 Capella | Atria | 34 |
| 14 Canopus | Canopus | 14 |
| 15 Sirius | Capella | 13 |
| 16 Procyon | Dabih | 41 |
| 17 Regor | Deneb | 43 |
| 20 Dnoces | Denebola | 23 |
| 21 Alphard | Diphda | 2 |
| 22 Regulus | Dnoces | 20 |
| 23 Denebola | Earth | 47 |
| 24 Gienah | Enif | 44 |
| 25 Acrux | Fomalhaut | 45 |
| 26 Spica | Gienah | 24 |
| 27 Alkaid | Menkar | 7 |
| 30 Menkent | Menkent | 30 |
| 31 Arcturus | Mirfak | 10 |
| 32 Alphecca | Moon | 50 |
| 33 Antares | Navi | 3 |
| 34 Atria | Nunki | 37 |
| 35 Rasalhague | Peacock | 42 |
| 36 Vega | Planet | 00 |
| 37 Nunki | Polaris | 5 |
| 40 Altair | Procyon | 16 |
| 41 Dabih | Rasalhague | 35 |
| 42 Peacock | Regor | 17 |

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| | | | |
|----|-----------|---------|----|
| 43 | Deneb | Regulus | 22 |
| 44 | Enif | Rigel | 12 |
| 45 | Fomalhaut | Sirius | 15 |
| 46 | Sun | Spica | 26 |
| 47 | Earth | Sun | 46 |
| 50 | Moon | Vega | 36 |

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

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- *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 (rate drive) *
- 59 Please Calibrate
- *60 Set N17 = N20
- *61 Display DAP att error
- *62 Display total att error (22-20)
- *63 Display total astro att error (17-20)
- 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 RMS Error Display
- *68 CSM Stroke Test on (LM)
- *69 Restart
- 70 Update Liftoff Time (P27)
- 71 Univ Update-BLOCK ADR (P27)
- 72 Univ Update-SINGLE ADR (P27)
- 73 Update CMC Time (Octal) (P27)
- *74 Initialize erasable dump via downlink
- *75 Backup Liftoff
- *76 Set preferred att flag (track axis)
- *77 Reset preferred att flag (X-axis)
- *78 Update prelaunch azimuth
- 79 Start Lunar LMK selection (R35)
- *80 Update LM State Vector
- *81 Update CSM State Vector
- 82 Start Orbit Param Disp (R30)
- 83 Start REND Param Display (R31)
- 85 Start REND Param Display No.2 (R34)
- *86 Reject REND backup sighting mark
- *87 Set VHF range flag

- *88 Reset VHF range flag
 - 89 Start REND Final ATT Routine (R63)
 - 90 Request REND out of plane display (R36)
 - 91 Compute Banksum
 - *92 Start IMU performance test (P07)
 - *93 Enable W matrix initialization
 - *94 Enable CISLUNAR Tracking recycle
 - *96 Terminate integration and go to P00
 - 97 SPS Thrust Fail (R40)
 - 99 Enable engine ignition
- *Callable with other extended verb in use
and does not lock out other extended verbs.

NOUN LIST (Decimal)

| | | |
|----|-----------------------------------------------|----------------|
| 01 | Specify Machine Address (Fract) (R1,R2,R3) | .XXXXX |
| 02 | Specify Machine Address (Whole) (R1,R2,R3) | |
| 03 | Specify Machine Address (can be R1,R2,R3) | .01° |
| 05 | Angular Error/Diff | .01° |
| 06 | Option Code (R1 & R2) | OCTAL |
| 07 | FLAGWORD operator, ECADR, BIT ID, Action | |
| 08 | Alarm Data | OCTAL |
| 09 | Alarm Codes | OCTAL |
| 10 | Channel to be Specified (R1) | OCTAL |
| 12 | Same as 06 in R30 | |
| 15 | Increment Machine Address (R1) | OCTAL |
| 16 | Time of event | hrs,min,.01sec |
| 17 | Astronaut total att | R,P,Y .01° |
| 18 | Auto Maneuver | R,P,Y .01° |
| 20 | Present ICDU Angles | R,P,Y .01° |
| 21 | PIPA PULSES X,Y,Z | Pulses |
| 22 | New ICDU Angles | R,P,Y .01° |
| 24 | Delta CMC Clock Time | hrs,min,.01sec |
| 25 | Checklist (please perform) | |
| 26 | Prio/Delay, ADRES, BBCON(R1,R2 & R3) | OCTAL |
| 27 | Self-Test on/off sw | |
| 29 | X SM LAUNCH Azimuth | .01° |

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| | | |
|----|-----------------------------|------------------------------------------------|
| 30 | Target Code(Gyrocomp verif) | |
| 31 | Time of landing site | hrs,min,.01sec |
| 32 | Time from Perigee | hrs,min,.01sec |
| 33 | Time of Ignition (GETI) | hrs,min,.01sec |
| 34 | Time of Event | hrs,min,.01sec |
| 35 | Time from Event | hrs,min,.01sec |
| 36 | Time of CMC Clock | hrs,min,.01sec |
| 37 | GETI-TPI | hrs,min,.01sec |
| 38 | State Vector Time | hrs,min,.01sec |
| 39 | A Time of Transfer | hrs,min,.01sec |
| 40 | TF GETI/TFC | min-sec |
| | VG | .1 FPS |
| | ΔV (Accumulated) | .1 FPS |
| 41 | Target | Azimuth .01° Elevation .001° Ident 0000X |
| 42 | Apogee Alt (HA) | .1 NM |
| | Perigee Alt (HP) | .1 NM |
| | ΔV (Required) | .1 FPS |
| 43 | Lat | .01° (+ North) |
| | Long | .01° (+ East) |
| | Alt | .1 NM |
| 44 | Apogee Alt (HA) | .1 NM |
| | Perigee Alt (HP)(N50) | .1 NM |
| | TFF | min-sec |
| 45 | Marks | XXBXX |
| | TF GETI of next burn | min-sec |
| | MGA | .01° |
| 46 | DAP Config (R1&R2) | OCTAL |
| 47 | CSM weight | LBS |
| | LM Weight | LBS |
| 48 | Pitch Trim | .01° |
| | Yaw Trim | .01° |
| 49 | ΔR | .1 NM |
| | ΔV | .1 FPS |
| | SOURCE CODE | 0000X. |
| 50 | ΔR (miss distance) | .1 NM |
| | PERIGEE (HP) | .1 NM |
| | TFF | min-sec |

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| | | |
|----|--------------------------------------|----------------------|
| 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 | CODE |
| | R2 E(ELEV ANGLE) | .01° |
| | R3 CENTANG (passive veh) | .01° |
| 57 | ΔR offset (SOR) | .1 NM |
| | (+ indicates behind passive vehicle) | |
| 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 | .01 G |
| | V Pred | FPS |
| | Gamma EI | .01° |
| 61 | Impact Lat | .01° |
| | Impact Long | (+ North) .01° |
| | Head Up/Down | (+ East) +/-00001 |
| | | (+ Heads up) |
| 62 | VI-Inertial Vel Mag | FPS |
| | H Dot-Alt Rate | FPS |
| | H-Alt Above Pad Radius | .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 |
| | RTOGO to Target | .1 NM |
| 65 | Sampled CMC Time | hrs,min,.01 sec |
| | (fetched in interrupt) | |

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| 66 | Beta, CMD Bank Angle | .01° |
| | CRSRNG Range Error | .1 NM |
| | DNRNG Range | .1 NM |
| 67 | RTOGO to Target | .1 NM |
| | Lat, Present Position | .01° |
| | Long, Present Position | (+ North) .01° (+ East) |
| 68 | Beta, CMD Bank Angle | .01° |
| | VI, Inertial Vel. | FPS |
| | H Dot, Alt Rate | FPS |
| 69 | Beta | .01° |
| | DL | .01 G |
| | VL | FPS |
| 70 | Star Code(before mark) | OCTAL |
| | LMK Data | OCTAL |
| | Horiz data | OCTAL |
| 71 | Star code (after mark) | OCTAL |
| | LMK Data | OCTAL |
| | Horiz data | OCTAL |
| 72 | Δ ang | .01° |
| | Δ alt | .1 NM |
| | Search option | |
| 81 | ΔVX,Y,Z (lcl vert) | .1 FPS |
| 83 | ΔVX,Y,Z (Body Control Axis) | .1 FPS |
| 84 | ΔVX,Y,Z (Other Vehicle) | .1 FPS |
| 85 | VGX,Y,Z (Body Control Axis) | .1 FPS |
| 87 | Opt Calib Data - Shaft (R1) | .01° |
| | Trunnion(R2) | .001° |
| 88 | Planet | X |
| | | Y |
| | | Z |
| 89 | Landmark - Lat | .001° |
| | Long/2 | (+ North) .001° (+ East) |
| | Alt | |
| 90 | REND out of | Y |
| | Plane para | Y DOT |
| | | PSI |
| 91 | OCDU Angles | .01° |
| | Shaft (R1) | .01° |
| | Trunnion (R2) | .001° |

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| 92 | New OCDU Angles Shaft (R1) Trunnion (R2) | .01° .001° |
| 93 | Delta Gyro Angles X,Y,Z | .001° |
| 94 | OCDU ANGLES (R56)(R23) R1 SHAFT R2 TRUNNION | .01° .001° |
| 95 | Pref att ICDU angles | .01° |
| 96 | +X axis att ICDU angles | .01° |
| 97 | System Test Inputs | XXXXXX. XXXXXX. XXXXXX. XXXXXX. .XXXXXX |
| 98 | System Test Results | XXXXXX. XXXXXX. XXXXXX. XXXXXX. |
| 99 | POS ERR VEL ERR OPTION Code | .01 NM 0.1 FPS .XXXXXX |

COL 249 ALARM CODES AND CREW RESPONSE

- 00110 Mark reject has been entered but ignored.
Continue
- 00112 Mark reject with no marks being accepted.
Continue
- 00113 No inbits (Channel 16)
Continue
- 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 ZERO altered before 15 sec 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
V41N91 not yet available
- 00120 Optics torque has been requested but optics
have not been zeroed since last fresh start
or restart
OPTICS ZERO-ZERO

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- (m)00121 In 0.05 sec following mark, an ICDU changed by more than 0.033 degrees
Repeat MK (G&N 10/1)
- 00122 Marking not called for
Continue
- 00124 P17(77) TPI search unsuccessful
(CMP 4-1)
- (m)00205 PIPA saturated
Use SCS control
(G&N 12)
- 00206 The IMU zero routine has been entered with both GMBL LOCK 1t and NO ATT 1t ON
Coarse align to 0,0,0 Reselect V40N20 E
- (m)00207 ISS turn-on request not present for 90 sec
Redo IMU turn on(G&N 12)
- (m)00210 IMU not operating
Redo IMU turn-on, if alarm recurs perform fresh start (V36E). Consult MSFN
- (m)00211 Coarse align error
If P51/P52 in progress record gyro torquing angles and perform fine align check in P52.
If P51/P52 not in progress see CMP 3-3.
- (m)00212 PIPA fail but PIPA not being used
PIPA BIAS check
- (m)00213 IMU not operating with turn-on request
See 00210
- 00214 Program using IMU when turned off
Exit program
- (m)00217 IMU coarse align or pulse torque difficulty has occurred
Reinitiate program. If alarm recurs continue.
- 00220 IMU orientation unknown
Align or set REFSMMAT flag if aligned.
- 00401 Desired MGA exceeds 70°
Call N22, manually maneuver if MGA < 85° or realign IMU; if in P52 see CMP 7-2.
- 00404 Target out of view (90° test).
(CMP 4-5, 4-8, 7-3, E1-7)
- 00405 Acceptable star pair not available
(CMP 1-2, 7-2, 7-6, E1-6)
- 00406 Rendezvous navigation not operating.
Select P20 or continue.

- 00407 Target out of view (50° test)
(CMP 4-2, 4-5, 4-8, 7-3, E1-7)
- 00421 W-matrix overflow
Notify MSFN but continue, W-matrix is automatically initialized at next mark.
- 00605 Number of iterations exceeds loop max.
(CMP 5-4, 5-5)
- 00611 No TIG for given ELEV angle
(CMP 5-2)
- 00612 SV in wrong sphere of influence.
(CMP 5-4)
- 00613 Reentry angle out of limits
(CMP 5-5)
- (m)00777 ISS warning caused by PIPA fail
See ISS warning malfunction procedures
- 01102 CMC Self Test Error (3-9, E1-10)
- *01103+ Unused CCS Branch Executed
- Copy N08, notify MSFN, but continue
- **01104 Delay Routine Busy
Reselect extended verb or continue with program
- (m)01105 Downlink Too Fast
Rset. If alarm recurs, downlink failure
- (m)01106 Uplink Too Fast
Rset. If alarm recurs, uplink failure
- (m)01107 A Restart Failure Caused Fresh Start
Perform the following:
V74, P27, V48, V46, revalidate REFSMMAT by P51 or set flag; if fresh start recurs, CMC failure.
- **01201 Executive Overflow-No Vac Area
Reselect extended verb or continue with program
- **01202 Executive Overflow-No Core Sets
See 01201
- **01203 Waitlist Overflow-Too Many Tasks
See 01201
- *01206+ Two Jobs Try To Sleep In Pin Ball
See 01201

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- **01207 No Vac Area For Marks
Reselect P51/P52
- *01210 + Two Routines Using Device At Same Time
Reselect extended verb when indicated device
is no longer in use
- **01211 Illegal Interrupt Of Extended Verb
Reselect program
- 01301 ARCSIN-ARCCOS Input Angle Greater Than 1
Copy N08 data, notify MSFN, continue
- *01302 + SQRT Called With Negative Argument
See 01301
- (m)01407 VG Increasing
(CMP 6-3, E2-3)
- 01426 IMU Unsatisfactory
Realign or use SCS
- 01427 IMU Reversed
Note FDAO operation is inverted
- *01501 + Illegal Internal Use of Pinball
See 01301
- *01502 + Illegal Flashing Display
See 01301
- 01520 V37 Request Not Permitted At This Time
Reselect V37
- 01600 Overflow In Drift Test
This is grd test alarm only
- 01601 Bad IMU Torque Abort
See 01600
- 01602 Bad Optics During Verification
See 01600
- 01703 Insufficient Time For Integration-TIG Slipped
(CMP 6-2, E2-2)
- (m)03777 ISS Warning Caused By ICDU Fail
ISS Warning malfunction procedures
- (m)04777 ISS Warning Caused By ICDU And PIPA Fail
See 03777
- (m)07777 ISS Warning Caused By IMU Fail
See 03777
- (m)10777 ISS Warning Caused By IMU And PIPA Fail
See 03777

(m)13777 ISS Warning Caused By IMU And ICDU Fail

See 03777

(m)14777 ISS Warning Caused By IMU, ICDU, and PIPA
Fail

See 03777

(m) Malfunction 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

Alarms for V05 N09

R1 First alarm to occur

R2 Second alarm to occur

R3 Third Alarm to occur

(May be of the form 4xxxx or 5xxxx, where 4xxxx
indicates more than 3 alarms and 5xxxx indicates more
than 3 alarms, one of which was 1xxxx.)

+ INDICATED ALARMS RESULT IN POO DOA ABORTS.

IF A POO DOA ABORT TAKES PLACE DURING

PERMANENT INTEGRATION (POO OR DURING MARKS)

RESET THE FOLLOWING FLAGS:

REINTFLG V25N7E 106E 100E E

STATEFLG V25N7E 77E 20E E

NODOFLG RESET BY RESELECTION OF POO

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V50N25 CHECKLIST CODES

| <u>R1 Code</u> | <u>ACTION</u> | <u>FUNCTION</u> |
|----------------|---------------|----------------------------|
| 00014 | Key in | Fine Align Option |
| 00015 | Perform | Celestial Body Acquisition |
| 00016 | Key in | Terminate Mark Sequence |
| 00041 | Switch | CM/SM SEP to UP |
| 00062 | Key | CMC to STBY |
| 00202 | Perform | PGNS AUTO MNVR |
| 00204 | Key in | Engine gimbal test option |

V04 N06 OPTION CODES

| <u>R1 Code</u> | <u>Purpose</u> | <u>Input for R2</u> |
|----------------|---------------------------|-------------------------------------|
| 00001 | Specify IMU Orientation | 1=PREF, 2=NOM 3=REFS, 4=LDG SITE |
| 00002 | Specify vehicle | 1=CSM, 2=LM |
| 00003 | Specify tracking Attitude | 1=Preferred, 2=+X-axis |
| 00005 | Specify SOR Phase | 1=First, 2=Second |
| 00007 | Specify Propulsion System | 1=SPS, 2=RCS |

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PROGRAM NOTES

- 1 Some nouns are not manually callable with valid data at any time, e.g. 1, 2, 3, 5, 6, 7, 10, 12, 15, 16, 24, 25, 26, 29, 30, 31, 34, 41, 72, 97, 98.
- 2 The following nouns can never be loaded via V24 or V25: 40, 44, 45, 50, 63, 80.
- 3 V37 should not be called for 20 seconds after the NO ATT light goes off. If it is, the PIPA FAIL inhibit bit will not be reset and a PIPA FAIL will go undetected.

Recovery Procedure: Select P00. Reset IMODES 30 Bit 5 via V25N07E, 1320E, 20E, E; or turn on P47 and exit after first display.

- 4 An infinite loop in coasting integration can occur under the following conditions:
 - 1) faulty (e.g. sub-surface) state vectors of the extrapolation of faulty state vectors to sub-surface conditions.
 - 2) lengthy extrapolation of "valid" state vectors (i.e., continuing nominal uncertainties) to sub-surface conditions, e.g. P21 integration from post-TLI to time-of-perilune.

Recognition: Excessive time to update state vector, verified by V16N38E producing small oscillating time steps.

Recovery Procedure: V96E to stop integration loop. Since an integration loop may have been caused by faulty CSM and/or LM state vectors a P27 state vector update may be required.

*V96 IS HAZARDOUS DURING P20
WHEN COMP ACTY LT ON & KR LT ON AFTER HV37 PROG SELECTION.
EITHER MAY CAUSE LOSS OF W MATRIX SYNC.*

- 5 The following program sequences will cause problems:
 - a) P3X - P7X - P40 or P41
 - P3X - P17 - P40 or P41
 - P3X - P23 - P40 or P41

Problem: P3X computations are overwritten.

Recovery Procedure: Redo P3X and then P40 or P41.

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b) P40/P41 - P27 - P52

Problem: P27 overwrites preferred computation.

Recovery Procedure: Redo P40/P41 up to V50N18, then reselect P52.

c) P01 after liftoff.

Problem: Coarse alignment to 0,0,0 (no attitude light on); W-Matrix correlation is lost; possible call of P02 and, if liftoff bit is set, P11. This will turn on Average-G, destroy TEPHEM and REFSMMAT.

Recovery Procedure: 1) The recognition of P01 in the mode lights must be followed immediately by V96E as P01 will remain for 30 seconds and then might automatically cycle to P02 and possibly P11, which is far more severe and would require a complete erasable uplink.

2) Do a V93E to re-initialize W-matrix. 3) Perform P51 and P52. 4) Select P00.

d) V92 during P00. (07 appears in MODREG)

Problem: 1) Turns off DAP

(a) Sets T5LOC to T51LOC

(b) Zeros Bits 15 & 14 of Flag 6

2) Zeros or overwrites W-matrix

3) Coarse aligns to 0,0,0

4) Does a Clean Dsp and stops with a flashing V06N42 display.

Recovery: 1) Do a V93E to reinitialize W-Matrix.

2) Perform P51 & P52

3) Select P00

4) If RCS DAP control is required, do V46E to reestablish DAP.

6 If a data load on N81 display in P34 or P35 is interrupted by a priority display or a restart, the ENTER on the data load might not set the new target flag.

AVOIDANCE PROCEDURE: None

Recovery Procedure: After a response to a priority display or a restart, reload data or V32E when V06N81 display comes back, or reselect P34 or P35.

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- 7 A restart in R50 (coarse align) will cause gimbal angles to be recomputed incorrectly after a recovery from that restart. Also, the star selection routine and auto optics will function incorrectly.

AVOIDANCE PROCEDURE: None

Recovery Procedure: 1) Finish P52 manually then do align check automatically. 2) Get out of program then do P51 and P52 (#1 is recommended).

- 8 If P40 is exited via V37 between the engine gimbal drive test and ignition + 0.4 seconds, Channel 12 Bits 2, 8, and 11 will not be reset. This means that the OPTICS will drive the SPS; also, OPTICS will not drive.

AVOIDANCE PROCEDURE: Do not make a V37 request between the gimbal drive test and TIG + 0.4 seconds in P40.

Recovery Procedure: After selection of a new program, wait until the program number appears in the mode lights. Immediately thereafter key in V69E (hardware restart) which will zero the above mentioned channel bits.

- 9 TFF Display P61 in Error by 4 to 5 Min.

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G&N Recovery Procedures

If:

V79 -

V82E with both options for reasonableness
or V83E test for reasonableness
or P21 test for reasonableness

If nominal - continue:

if not get P27 SV update

If V92:

V93E

DO P51 & 52

P00

V46E

If:

V36-

V74 Revalidate REFSMAT by
P27 Auto-Optics (SXT STAR)
V48 Drift Flag Set By P51
V46 Proceed on Step 1
Select P00

GO JAM for tight RESTART
loop: Simultaneously
press RSET and MARK REJECT

If P01

V96 within 90 sec

V93E

P51

P00

V34 and V37 restrictions

Statement: "All use of V37EXXE is acceptable and all
V34E responses to flashing displays are acceptable with
the following exceptions:

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1. Do not key V37EXXE after V50 N25 - 00204 in P40 and before TIG. If you do key V69E when mode lights show XX.
2. Only V37E00E is allowed after separation (PRO on V50 N25 - 00041 in P62).
3. V34E is not allowed on V51 in P22 until at least one mark is made.

RESPONSES -TO V99 and V97 In P40

1. Never terminate (V34E) on a flashing V99 or V97. Use V37E 00E.
2. If V06 N16 results from a PROCEED or an ENTER to a flashing V99 or V97, terminate (V34E) and normal program displays will be restored. (V06 N16 comes up because the extended verb, V90, has been executed inadvertently by the program.)

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SECTION 3. 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 *

2 F 37 OOE

OPTICS POWER UP PROCEDURE

G/N PWR OPTICS - on (up)

OPTICS ZERO - OFF

OPTICS ZERO - ZERO (15 sec)

OPTICS POWER DOWN

G/N PWR. OPTICS - OFF

IMU POWER UP PROCEDURE

LOGIC POWER 2/3 - on

FDAI POWER - BOTH

FDAI SELECT - 1/2

CMC MODE - FREE

G/N IMU PWR - on (up)

NO ATT lt - on (90 sec)

NO ATT lt - out

Wait 20 sec

2 V37E XXE

*If CMC Failed:

* G/N IMU PWR - on (up) *

* Wait 90 sec *

* IMU CAGE - on (up) 5 sec, *

* then off *

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1 P06 - CMC POWER DOWN PROGRAM
V48E
F 04 46 Load 0 (NO DAP) in left digit of R1
PRO
PRO

PRO

V46E

2

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

IMU POWER DOWN PROCEDURE
CMC MODE - FREE

1

G/N IMU PWR - OFF
ISS warning
RSET

1

P76 - TARGET ΔV
F 06 84 V37E 76E (.1fps)
ΔV XYZ
Load ΔV
PRO

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

3 F 37

3. GEN GENERAL

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

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CMP

3-3

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
*Reduce SC drift *
*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 DATA LOAD PROCEDURE

V48E

- F 04 46 R1 ABCDE
R2 ABCDE

| VEHICLE CONFIG | QUAD A/C FOR X | QUAD B/D for X | ERR DEADBAND | RATE SELECT |
|----------------|----------------------------------------------------------------------------------------------|-----------------------------|-----------------------------|-------------------------------|
| R1 | 0 = No DAP 1 = CSM 2 = CSM & LM 3 = CSM & SIVB 6 = CSM & LM (Ascent Stg only) | 0 = Fail A/C 1 = Use A/C | 0 = Fail B/D 1 = Use B/D | 0 = ± 0.5° 1 = ± 5.0° |
| R2 | Roll Quad Select | Quad A | Quad B | Quad C |
| | 0 = Use B/D 1 = Use A/C | 0 = Fail 1 = Use | 0 = Fail 1 = Use | Quad D 0 = Fail 1 = Use |

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1

PRO

- 2 F 06 47 CSM WT, LM WT (1bs,1bs)
 Load correct values
 PRO
- 3 F 06 48 TRIM ENGINE GMBL (.01°)
 Load correct values
 PRO (To Prog In Progress)
- 4 V46E if A of N46 R1 changed

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 (.01°)
 (TRIM) PRO to 4
 (BYPASS) ENTR

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CMP
3-5

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V55 - CMC TIME UPDATE

V37E 00E

V55E

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

V64 START S-BAND ANTENNA

V37E 00E

2 V64E

F 06 51 RHO, GAMMA (.01°,.01°)

S-BAND ANT - S

TRACK - MAN

Check P&Y Angle Ind

TRACK - AUTO

PRO

V67 - W-MATRIX ERROR DISPLAY

V67E

F 06 99 POS ERR, VEL ERR, OPT CODE(.01nm,.1fps)

R3 00001=Rend

00002=Orbital

00003=Cislunar

Load desired data

To reinitialize Rend W-Matrix,

Load: R1 +00028

R2 +00017 = 1000-1

R3 +00001

PRO

V74 CMC DOWNLINK

V21 N01E 333E

R3 333

R1 20000E for 4 Dumps

or 10000E for 2 Dumps

or 04000E for 1 Dump

1 (If needed)

F 21 01

2 V74E (Places erasable memory on downlink)

V79 LUNAR LANDMARK (DO NOT USE)
V37E 00E

- 1 V79E
- 2 F 06 34 LAT-LONG TIME (hrs,min,.01sec)
Load desired time
PRO
- 3 F 06 31 LDG SITE TIME (hrs,min,.01sec)
PRO
- 4 F 05 70 LMK CODE
R2=000DE
(RECYCLE) V32E to 4
PRO
- 5 F 06 34 LMK TIME (hrs,min,.01sec)
PRO To 4 Until 5 LMK Are Cycled Then Exit

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Feb 20, 1969V82 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
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 & P00) N50E To 3
(TF PER) N32E To 4
(EXIT) PRO
- 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

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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

V37E 00E

Feb. 1, 1969 1
Basic Date F 16 54 V83E
Changed Feb. 20, 1969 RANGE, RANGE RATE, THETA (.01nm,.1fps,.01°)
PRO

V85 - RNDZ PARAMETER DISPLAY #2

Note: See V83 note

V85E
F 16 53 RANGE, RANGE RATE, PHI (.01nm,.1fps,.01°)
PRO

V89 - RENDEZVOUS FINAL ATTITUDE

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

1 V37E 00E
V62E
2 V89E
F 04 06 R1 00003 SPECIFY TRACKING ATTITUDE
R2 00001 (PREF)
00002 (+X AXIS)
PRO

CMP
3-8

3 F 06 18 FINAL FDAI RPY ANGLES (.01°)

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

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

V90E GET EVENT (hrs,min,.01sec)

Load desired time

PRO

1 F 06 16 (.01nm,.1fps,.01°)

F 06 90 Y,YDOT,PSI
(RECYCLE) V32E to 1

(EXIT) PRO

V91 - COMPUTE BANKSUM

CMC - on (req)

V37E 00E

V91E
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

| | | |
|-----------------------------------------------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | CMC SELF CHECK |
| 1 | F 21 01 | V25 N01E, 1365E E,E,E |
| 2 | 15 01 | V15 N01E, 1365E R1 NUMBER OF ERRORS R2 NUMBER OF TESTS STARTED R3 NUMBER OF TESTS SUCCESSFUL |
| 3 | | V21 N27E 10E SELF TEST, FIXED & ERASABLE (4E SELF CHECKS ERASABLE 5E SELF CHECKS FIXED) |
| 4 | 15 01 | KEY REL TEST SUCCESSFUL WHEN R2>3 (78 sec) *IF PROG 1t - on * *V05 N09E 01102 SELF* * TEST ERROR* (TERM) V21N27E 0E *N08E-Rcd for MSFN* |
| <hr/> <u>MEASUREMENT & LOADING OF PIPA BIAS</u> | | |
| 1 | | DET - RESET SC RATES <0.1°/sec |
| 2 | | V25N 21E, E,E,E/Start Event Timer |
| 3 | 16 21 | V16 N21E XYZ PIPA COUNTS |
| 4 | | At T + 4:16 - VERB T4:16 (X) R1 ____ (Y) R2 ____ (Z) R3 ____ (XXXAB) |
| 5 | F 21 01 | V21N 01E LOAD 1452 E (CALCULATED X BIAS) E,E,(+ABXXX) 1454 E (CALCULATED Y BIAS) E,E 1456 E (CALCULATED Z BIAS) E |
| -> 26400 update | | |

FLAG WORD SET/RESET

- 1 V25N 07E
(LOAD FLAG WORD ADDRESS) E
- 2 F 22 07 (LOAD CODE FOR BIT TO BE CHANGED) ABCDE ENTR
- | BIT | A | B | C | D | E |
|------|-------------------------------------|-------------------------------|---|---|---|
| CODE | 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 | 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 | | | |
- 3 F 23 07
(SET BIT) Key 1E
(RESET BIT) Key 0E
- 4 (To Verify) V01 N01E (FLAG Word ADD) ENTR
- 5 F 01 01 R1 FLAG WORD (ABCDE)
R3 FLAG WORD ADDRESS

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EXAMPLE: To set REFSMMAT flag:

Key:

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

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

REVIEW DATA IN ERASABLE MEMORY
Perform During Any Flashing Display

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 1
 2
 3
 4
 1

V01 NOTE (OCTAL ADD) E

01 01 R1 DATA R3 OCTAL ADD

N15E (For next succeeding word)

ENTR (For each succeeding word)

TO CHANGE DATA IN ERASABLE MEMORY

F 21 01

V21 NOTE (ADDRESS) E

R3 ADDRESS

Load New Data in R1 E

N15E (For next succeeding word)

ENTR (For each succeeding word)

COAS LOS DETERMINATION

CMC - on

ISS - on

SCS - operating

SC CONT - SCS

MAN ATT (3) - MIN IMP

G/N PWR OPTICS - on

OPT MODE - CMC

OPT ZERO - ZERO (verify)

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1

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
OPTICS ZERO - ZERO

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DSKY CONDITION LIGHT TEST
CMC - on

1 Key V37E OOE (desired)
 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. Old PROG number will be displayed
Interrupted display (if any) will
be restarted

MONITOR OF INPUT/OUTPUT CHANNELS

V21 N1OE

F 11 10 (LOAD CHANNEL ADDRESS) E
R1 Octal Contents of Specified
Channel

LOAD OUTPUT CHANNELS

V21 N1OE

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

PITCH ORBIT RATE MANEUVER

(Save RCS - Disable 2 Adjacent Quads in
R03)

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

ENTR

5

V24 N01E
3127E
VVVVV E
WWWWW E

7

V24E
3131E
XXXXX E
YYYYY E

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8

V21E .068°/sec .54142 = Z
 3200 E
 ZZZZ 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

TABLE 1

CDUX

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CSM 104

| ORBRATE | 0 deg | +90 deg | +180 deg | +270 deg |
|-------------------|-------------|---------|----------|----------|
| -0.100 deg/sec | VVVVV=77774 | 00000 | 00003 | 00000 |
| | WWWWW=53400 | 61300 | 23500 | 16500 |
| | XXXXX=00000 | 00003 | 00000 | 77774 |
| | YYYYY=61300 | 23500 | 16500 | 54300 |
| | ZZZZZ=42676 | 42676 | 42676 | 42676 |
| -0.095 | VVVVV=77774 | 00000 | 00003 | 00000 |
| | WWWWW=62200 | 62000 | 15600 | 16000 |
| | XXXXX=00000 | 00003 | 00000 | 77774 |
| | YYYYY=62000 | 15600 | 16000 | 62200 |
| | ZZZZZ=44250 | 44250 | 44250 | 44250 |
| -0.090 | VVVVV=77774 | 00000 | 00003 | 00000 |
| | WWWWW=70000 | 62600 | 10000 | 15200 |
| | XXXXX=00000 | 00003 | 00000 | 77774 |
| | YYYYY=62600 | 10000 | 15200 | 70000 |
| | ZZZZZ=45622 | 45622 | 45622 | 45622 |
| -0.085 | VVVVV=77774 | 00000 | 00003 | 00000 |
| | WWWWW=75600 | 63400 | 02200 | 14400 |
| | XXXXX=00000 | 00003 | 00000 | 77774 |
| | YYYYY=63400 | 02200 | 14400 | 75600 |
| | ZZZZZ=47173 | 47173 | 47173 | 47173 |

CMP
3-16

| | 0 deg | +90 deg | +180 deg | +270 deg |
|-------------------|-------------|---------|----------|----------|
| -0.080 | VVVVV=77775 | 00000 | 00002 | 00000 |
| | WWWWW=43400 | 64100 | 34400 | 13700 |
| | XXXXX=00000 | 00002 | 00000 | 77775 |
| | YYYYY=64100 | 34400 | 13700 | 43400 |
| | ZZZZZ=50545 | 50545 | 50545 | 50545 |
| -0.075 | VVVVV=77775 | 00000 | 00002 | 00000 |
| | WWWWW=51300 | 64700 | 26500 | 13100 |
| | XXXXX=00000 | 00002 | 00000 | 77775 |
| | YYYYY=64700 | 26500 | 13100 | 51300 |
| | ZZZZZ=52117 | 52117 | 52117 | 52117 |
| -0.070 deg/sec | VVVVV=77775 | 00000 | 00002 | 00000 |
| | WWWWW=57100 | 65500 | 20700 | 12300 |
| | XXXXX=00000 | 00002 | 00000 | 77775 |
| | YYYYY=65500 | 20700 | 12300 | 57100 |
| | ZZZZZ=53467 | 53467 | 53467 | 53467 |
| -0.065 | VVVVV=77775 | 00000 | 00002 | 00000 |
| | WWWWW=64700 | 66300 | 13100 | 11500 |
| | XXXXX=00000 | 00002 | 00000 | 77775 |
| | YYYYY=56300 | 13100 | 11500 | 64700 |
| | ZZZZZ=55041 | 55041 | 55041 | 55041 |
| -0.060 | VVVVV=77775 | 00000 | 00002 | 00000 |
| | WWWWW=72500 | 67100 | 05300 | 10700 |
| | XXXXX=00000 | 00002 | 00000 | 77775 |
| | YYYYY=67100 | 05300 | 10700 | 72500 |
| | ZZZZZ=56413 | 56413 | 56413 | 56413 |
| -0.055 | VVVVV=77776 | 00000 | 00001 | 00000 |
| | WWWWW=40300 | 67600 | 37400 | 10200 |
| | XXXXX=00000 | 00001 | 00000 | 77776 |
| | YYYYY=67600 | 37400 | 10200 | 40300 |
| | ZZZZZ=57765 | 57765 | 57765 | 57765 |
| -0.050 | VVVVV=77776 | 00000 | 00001 | 00000 |
| | WWWWW=46200 | 70400 | 31600 | 07400 |
| | XXXXX=00000 | 00001 | 00000 | 77776 |
| | YYYYY=70400 | 31600 | 07400 | 46200 |
| | ZZZZZ=61337 | 61337 | 61337 | 61337 |

Basic Date Feb. 1, 1969
 Changed Feb. 20, 1969

CSM 4

PASSIVE THERMAL CONTROL

| | | |
|---|--------------------|--------------------------------------------------------------------------------------|
| 1 | | 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 | F 06 18 F 50 18 | AUTO MANEUVER |
| 5 | | ENTR +0.1°/s -0.1°/s |
| 6 | | V24N01E V24N01E 3125E 3125E 00003E 77774E 24400E 53400E |
| 7 | | V21E V21E 3176E 3176E 35101E 42676E |

Basic Date 1, 1969
Changed Feb.
 Feb.

FLAG WORD LISTING

| <u>TITLE</u> | <u>ADDRESS</u> | <u>BIT</u> | <u>WHEN SET</u> | <u>WHEN RESET</u> |
|--------------|----------------|------------|--------------------------------------|--------------------------------------------|
| RNDZ | 00074 | 7 | P20 initiated | P20 terminated |
| UPDATE | 00075 | 7 | State vector update by marks allowed | State vector updating by marks not allowed |
| Track | 00075 | 5 | RNDZ Tracking allowed | Rendezvous tracking not allowed |
| Pref Att | 00076 | 4 | Pref Att computed | Preferred S/C attitude not computed |
| Steer | 00076 | 11 | Steering to be done | Steering omitted |
| Drift | 00076 | 15 | IMU Compen Allowed | |
| REFSMMAT | 00077 | 13 | REFSMMAT good | REFSMMAT not good |
| IMU | 00074 | 8 | IMU in use | IMU not in use |
| State Vector | 00075 | 8 | CSM State vector updated | LM state vector updated |
| Terminate | 00103 | 15 | Terminate R52,R53 | Do not terminate |

CWP 3-18

CSM 34

Basic Date Feb. 1, 1969
Changed Feb. 20, 1969

Basic Date Feb. 1, 1969
 Changed Feb. , 1969

| | | | | |
|-----------------|-------|----|----------------------------------|-----------------------------------------------------------------|
| Trunnion drive | 00074 | 4 | Enables CMC contr of trunnion | CMC control of optics trunnion not enabled |
| Target 1 | 00075 | 10 | LM sighting | Not sighting LM |
| Target 2 | 00075 | 9 | LMK Sighting | Sighting star |
| W-matrix (REND) | 00101 | 1 | W-matrix valid | W-matrix for ren- dezvous naviga- tion is invalid |
| W-matrix (ORB) | 00077 | 6 | P22,23 W-matrix valid | P22,23 W-matrix for rendezvous navigation is invalid |
| 3 axis | 00101 | 6 | MNVR Specified by 3 axes | Maneuver speci- fied by 1 axis |
| External ΔV | 00076 | 8 | Ext ΔV VG comp | Lambert VG computations |
| Active vehicle | 00076 | 5 | LM active | CSM active |
| Final comp. | 00076 | 6 | Final RNDZ comp | Interim pass through rende- zvous program computations |

| | | | | |
|---------------|-------|----|-----------------------------------------------------|-----------------------------------------------------|
| Sighting mark | 00074 | 6 | V51 initiated | V51 not initiated |
| Stick flag | 00075 | 14 | RHC out of detent | RHC in detent (auto maneuver enabled) |
| CMOON flag | 00104 | 12 | Permanent CSM SV in Lunar Sphere of Influence | Permanent CSM SV in Earth Sphere of Influence |

NON-FLAGS

| | | | | |
|-----------|------|----|-------------------|-------------------|
| MARKSTAT | 1330 | 10 | After mark | After mark reject |
| IMODES 30 | 1320 | 9 | IMU not operating | IMU operating |

3-20

| A | B | C | D | E |
|----------|----------|-------|-------|-------|
| 15,14,13 | 12,11,10 | 9,8,7 | 6,5,4 | 3,2,1 |

| 1 Set | BINARY | - | OCTAL |
|---------|--------|---|-------|
| 0 Reset | 000 | - | 0 |
| | 001 | - | 1 |
| | 010 | - | 2 |
| | 011 | - | 3 |
| | 100 | - | 4 |
| | 101 | - | 5 |
| | 110 | - | 6 |
| | 111 | - | 7 |

CSM 104

Basic Date Feb. 1, 1969
 Changed Feb. 18, 1969

CSM 104

Basic Date Feb. 1, 1969
Changed Feb. 20, 1969V45
LMV67
CM

W-MATRIX TABLE

| WRENPOS | 2000-P20 2004-P22 | | WRENVEL | | 2001-P20 2005-P22 | |
|---------|----------------------|--------|---------|--------|----------------------|-------|
| | N99 R1 | 1000ft | OCTAL | N99 R2 | ft | OCTAL |
| 2.85 | 10 | 137 | 17.3 | 10 | 762 | |
| 2.28 | 8 | 114 | 13.9 | 8 | 620 | |
| 1.71 | 6 | 71 | 10.4 | 6 | 453 | |
| 1.14 | 4 | 46 | 6.9 | 4 | 307 | |
| .57 | 2 | 23 | 3.5 | 2 | 144 | |
| .28 | 1 | 11 | 1.7 | 1 | 61 | |
| .23 | .8 | 7 | 1.4 | .8 | 50 | |
| .17 | .6 | 5 | 1.0 | .6 | 34 | |
| .11 | .4 | 3 | .7 | .4 | 24 | |
| .06 | .2 | 2 | .3 | .2 | 10 | |
| .03 | .1 | 1 | .2 | .1 | 5 | |

3-21/22

SECTION 4. NAVIGATION

P17 - TPI SEARCH

or

P77 - LM TPI SEARCH

CMC - on (req)

- Basic Date Feb. 1, 1969
Changed
- 1 F 06 37 V37E 17E or V37E 77E
GETI (TPI) (hrs,min,.01sec)
Load desired GETI
PRO
- 2 F 06 72 Δ ANG(TPI), Δ ALT(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 *
- 3 F 06 58 HP, Δ V(TPI), Δ V(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

1 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 *
- * CMC MODE - AUTO *
- * V58E *
- *(MAN) MNVR to 2 (SXT) *
- * or to 3 (COAS) *

2 V57E (SXT)

- F 51 OPT MODE - MAN
 OHC - Cntr Target in SXT

MARK (repeat as necessary)

- *POSS F 06 49 ΔR,ΔV,source code*
- * (.1nm,.1fps,00001) *
- *(REJECT) V32E *
- *(ACCEPT) PRO *

OPT ZERO - ZERO

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 Changed Feb. 20, 1969

C 104
 * * *

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

- 3 F 06 94 V54E (COAS)
SHAFT, TRUNNION (.01°,.001°)
PRO
- 4 F 53 Request Alt LOS MARK
RHC - ALIGN Target in COAS
ENTR (V86E to reject)
POSS F 06 49 ΔR,ΔV,source code
(.1nm,.1fps,00001)
*(REJECT) V32E
*(ACCEPT) PRO
PRO (return to Program in process)
(To Terminate P20 - V56E)

P21 GROUND TRACK DETERMINATION
CMC - on (req)

Basic Date _____ Feb. 1, 1969
Changed _____

CSM 104

- 1 F 04 06 V37E 21E
00002, Specify Vehicle
00001, CSM
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°,.1nm)
(RECYCLE) V32E to 2 (Increment GET 10 min)
(EXIT) PRO
- 4 F 37 XXE

Basic Date Feb. 1, 1969
Changed Feb. 20, 1969

CSM 104

- CMP
4-5 P22
- 4 06 92 SHAFT,TRUN NEW OCDU (.01°,.001°)
*POSS Prog Alarm 1t(Trun 50°)
*V5 N9E 407
* 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
MARK (wait 10 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.
- PRO - if A=2 (or A is 1 & DE ≠ 0) to 8
- 7 F 06 89 LAT,LONG/2,ALT (.001°,.001°,.01nm)
PRO
- 8 F 06 49 ΔR,ΔV (ORB PARA) (.1nm,.1fps)
(RECYCLE) V32E to 2
(ACCEPT) PRO
- 9 F 06 89 LAT,LONG/2,ALT LMK ID (.001°,.001°,.01nm)
(DON'T STORE) V32E to 2
(EXIT) V34E
- 10 F 37 XXE
OPTICS ZERO - ZERO

P23 OPTICS CALIBRATION

CMC - on

OPT ZERO - ZERO (verify)

OPT MODE - MAN

- 1 F 05 70 V37E 23E (IMU NOT ALIGNED - To 3)
 STAR ID(ABCDE)/LMK ID/HOR ID
 Insure R1 DE \neq 00 and R3 \neq 00000
 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 (.001°)
 (Repeat until 2 measurements agree within .003°)
 (ACCEPT) PRO
 (REJECT) V32E - to 3
- 5 F 51 V37E XXE
 OPT ZERO - ZERO

P23 - CISLUNAR MIDCOURSE NAV MEASUREMENT

(Auto Maneuver first)

If alt above earth or moon < 432 nm, do not mark on secondary body.

CMC - on

SCS - on

ISS - on & aligned

G/N PWR OPTICS - on (30 min prior)

OPT ZERO - ZERO (verify)

OPT MODE - CMC

 Basic Date Feb. 1, 1969
 Changed Feb. 12, 1969

CSN 104

Basic Date
Changed

CSM 104

- 1 F 05 70 V37E 23E
STAR ID/LMK ID/HOR ID
Load codes (OCTAL)
- | | | |
|----------|----------|---------|
| STAR/ENH | STAR/LNH | STAR/EL |
| 000DE | 000DE | 000DE |
| 00000 | 00000 | 00100 |
| 00110 | 00210 | 00000 |
- | | | |
|----------|----------|---------|
| STAR/EFH | STAR/LFH | STAR/LL |
| 000DE | 000DE | 000DE |
| 00000 | 00000 | 002XX |
| 00120 | 00220 | 00000 |
- (STAR/LMK) PRO to 2 (XX#00 to 3)
(STAR/HOR) PRO to 3
- 2 F 06 89 LAT, LONG/2, ALT(LMK) (.001°, .001°, .01nm)
Load lmk coords
PRO
- 3 F 50 25 00202 MNVR REQUEST
PRO
REJECT - ENTR to 6
- 4 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO) SC CONT - CMC
CMC MODE - AUTO
PRO
(BYPASS MNVR/TRIM) - ENTR to 7 (If no cal go to 6)
- 5 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
AUTO MNVR complete return to 4
MAN MNVR - V62E
RHC - NULL ERROR NEEDLES Return to 4
- 6 F 59 REQUEST OPTICS CALIB
OPT MODE - CMC (verify)
OPT ZERO - OFF
ENTR (Until step 10, auto mnvr repeat - V94E to 4)

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- 7 06 92 AUTO OPTICS SHAFT,TRUN (.01°,.001°)
 *F 05 09 00404 (TA>90°) *
 *V94E to 4 (AUTO MNVR) *
 * or MAN MNVR - PRO to 7 *
 *PRG ALARM
 OPT MODE - MAN
 MNVR TO POSITION LMK/HOR IN FOV
- 8 F 51 REQUEST MARK
 OPTICS COUPLING - RESOLVED
 SPEED - LOW
 SUPERIMPOSE STAR ON LMK/HOR
 MARK
 (MARK REJECT) To 8
 (TERM) PRO
- 9 F 50 25 00016 TERMINATE MARKS
 OPTICS COUPLING - RESOLVED
 SPEED - LOW
 SUPERIMPOSE STAR ON LMK/HOR
 MARK
- 10 F 05 71 STAR ID/LMK ID/HOR ID (OCTAL)
 Verify codes
 (STAR/LMK) PRO to 11 (LMK XX#00 to 12)
 (STAR/HOR) PRO to 12
 Verify coordinates
 LAT,LONG/2,ALT(LMK) (.001°,.001°,.01nm)
- 11 F 06 89 LAT,LONG/2,ALT(LMK) (.001°,.001°,.01nm)
 Verify coordinates
 (PRO to 12)
 (SV Para) (.1nm,.1fps)
- 12 F 06 49 Rcrd data (R1-Trun in octal)
 Wait 30 sec
 KEY RLSF
 N38E, Record MARK time, KEY RLSF
 (REJECT) V37E 23E to 1
 (UPDATE) PRO

13 F 37 23E to 1
or 00E
OPT ZERO - ZERO

P27 CMC UPDATE
CMC - on (req)

Auto Update:

1 V37E 00E

UP TLM CM - ACCEPT

NOTE: UPTLM (LEB) always ACCEPT

UPLINK ACTY lt - on

- * POSS LOS before completion *
- * If V33 N02 showing: *
- * Key PRO *
- * UPLINK ACTY lt - out *
- * P00 displayed *
- * If V21 N01 *
- * or V21 N02 *
- * Key V34E *
- * UPLINK ACTY lt - out *
- * P00 displayed *
- * UP TLM CM - BLOCK *

Update complete:

UPLINK ACTY lt - out
V37E 00E
UP TLM CM - BLOCK

Voice Transmission Update:

1 V37E 00E

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

3 P27 Displayed

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CSM 104

- 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

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SECTION 5, PRETHRUST

P30 EXTERNAL ΔVIf uplinked REFSMMAT, do P52 (PREF OPT)
before P30

- | | | | |
|---|---------|-----------------------------------------------------------------------------|-------------------|
| 1 | F 06 33 | V37E 30E GETI Load desired GETI PRO | (hrs,min,.01sec) |
| 2 | F 06 81 | ΔVXYZ(LV) Load desired ΔV's PRO | (.1fps) |
| 3 | F 06 42 | HA,HP,ΔV(REQ) Set ΔV CTR PRO | (.1nm,.1nm,.1fps) |
| 4 | F 16 45 | M,TFI,MGA Set DET PRO (MGA Set to -00002 IF REFSMMAT FLAG NOT SET) | (0,min-sec,.01°) |
| 5 | F 37 | | |

Basic Date
ChangedP31 GENERAL LAMBERT PRETHRUST
TARG PARAMS - LOADED FROM GND (P27)

- | | | | |
|---|---------|----------------------------------------------|-------------------|
| 1 | F 06 33 | V37E 31E GETI Load desired GETI PRO | (hrs,min,.01sec) |
| 2 | F 06 81 | ΔVXYZ(LV) PRO | (.1fps) |
| 3 | F 06 42 | HA,HP,ΔV(REQ) Set ΔV CTR PRO | (.1nm,.1nm,.1fps) |

CSM 104

P31,34

4 F 16 45 M,TFI,MGA (0,min-sec,.01°)
 Set DET
 PRO (MGA Set to -00002 IF
 REFSMMAT FLAG NOT SET)

5 F 37

P34 TPI PRETHRUST (P74 LM)

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

2 F 06 55 R2 ELEV ANG, R3 wt (.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) PRO (Term Marking)

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

↓ F 06 37 TIG (TPI) (hrs,min,.01sec)
 (IF ELEV ANGLE COMPUTED BY CMC
 THIS DISPLAY WILL BE REPLACED
 BY F 06 55 AS IN 2 ABOVE)
 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 $\Delta VXYZ(LV)$ TPI (.1fps)
 (For Out-Of-Plane Corr in final Comp only)
 Key V90E

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Changed

C.104

CMP
5-3

P34,35

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

* LOAD OF NEW DATA INTERRUPTED *

* BY F 06 49, F 50 18 OR RESTART *

* HANDLE INTERRUPTION *

* RELOAD DATA WHEN *

* N81 REAPPEARS *

PRO

7 F 06 59 $\Delta VXYZ(LOS)TPI$ (.1fps)

PRO (If Recycle - To 3)

8 F 16 45 MARKS,TFI,MGA (marks,min-sec,.01°)

PRO (MGA SET To -00002 IF NO
REFSMMAT SET or If P74)

9 F 37

P74 - Transmit Mnvr Parameters To LM

P35 TPM PRETHRUST (P75 LM)

V37E (35E or 75E)

MARK,TFI,-00001 (marks,min-sec)

(RECYCLE) V32E To 3
(FINAL PASS) PRO (Terminate Marking)

2 F 06 81 $\Delta VXYZ(LV)TPM$ (.1fps)
(For Out-of-Plane Corr)

V90E

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)

CSM 104

Basic Date Feb. 1, 1969

Changed _____

*LOAD OF NEW DATA INTERRUPTED *
 BY F 06 49, F 50 18 OR RESTART
 * HANDLE INTERRUPTION *
 * RELOAD DATA WHEN *
 * N81 REAPPEARS *

PRO

3 F 06 59 $\Delta VXYZ(LOS)TPM$ (.1fps)
 PRO (If Recycle - To 1)

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

5 F 37 P75 - Transmit Mnvr Parameters To LM
P37 RETURN TO EARTH PROGRAM

1 F 06 33 V37E 37E
 TIG (hrs,min,.01sec)
 Load desired TIG
 PRO

2 F 06 60 BLANK,V PRED,GAMMA-1.75 SPS (fps,.01°)
 Load desired values -1.05 RCS
 FOR MIN ΔV -LOAD + 00000 IN R2
 PRO

*F 05 09 00605-Solution Not *
 * Convergent *
 * 00612-State Vector in *
 * Lunar Influence *
 *V32E,RSET To 1 *

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

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

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- 5 F 06 60 BLANK, VPRED, GAMMA EI (fps, .01°)
 (RECYCLE) V32E To 1 PRO
- 6 F 06 81 ΔVXYZ(LV) TIG (.1fps)
 PRO (To 3 on first pass)
- *F 05 09 00605 Solution Not *
 * Convergent *
 * 00613 Flt Path Angle *
 * Not Reached *
 * RSET *
 * V32E To 1 *
- 7 F 04 06 THRUST OPTION
 R1 00007
 R2 0000X
 X=1(SPS)
 2(RCS)
 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)
- P38 SOR TARGETING (P78 LM)
- 1 F 06 33 V37E (38E or 78E)
 TIG (SOR) (hrs,min,.01sec)
 Load desired TIG
 PRO
- 2 F 06 55 R3ωt (.01°)
 Load desired ωt
 PRO

P38,39

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CSM 104

- 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) (.1nm,.1fps,.1fps)
PRO
- 8 F 06 81 $\Delta VXYZ(LV)$ (.1fps)
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 $\Delta VXYZ(LV)$ (.1fps)
PRO (If Recycle - To 2)

Basic Date Feb. 1, 1969

CSM 104

Changed

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

Basic Date Feb. 1, 1969
Changed _____

CSM 104

SECTION 6. THRUSTING

P40 - SPS THRUSTING

CMC - on (Req)

ISS - on and aligned (Req)

SCS - on (Req)

TEST C/W Lamps

SET SPS GUAGING CONFIG

CRYO O2 & H2 MAN FAN OPERATION

RCS DAP - LOAD & ACTIVATE

ULLAGE SELECTION

TVC ROLL JETS

EMS ΔV TEST - 1586.8

V37E 40E

1 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO) BMAG MODE (3)-Rate 2

SC CONT - CMC

CMC MODE - AUTO

FOR 3 AXIS MANEUVER:

V37E 00E V49E

LOAD 06 22

PRO

AT COMPLETION P40

PRO

2 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
SPS He tb(2)-bp
SPS He v1v(2)-AUTO3 F 50 18 ATTITUDE TRIM ENABLE (.01°)
BMAG MODE(3)-RATE 2
ALIGN SC IN ROLL

PRO to 2 or continue

CHECK BORE SIGHT STAR (OPTICS & COAS)

CHECK PNL 8

AUTO RCS SELECT-A/C (B/D) ROLL(4)-OFF

SET ΔV ind (verify)

EMS FUNCT - ΔV

MAN ATT (3) - RATE CMD

ATT DB - MIN

Basic Date
Changed
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CSR 104

RATE - LOW
 TRANS CONT PWR - ON
 SCS TVC(2)-RATE CMD
 ΔV CG-LM or CSM
 -06:00 TVC GMBL DRIVE P&Y - AUTO
 MN BUS TIES (2) - ON
 TVC SERVO PWR 1 - AC1/MNA
 TVC SERVO PWR 2 - AC2/MNB
 ROT CONT PWR NORMAL (2) - AC
 ROT CONT DIRECT (2) - OFF
 BMAG MODE (3) - ATT 1/RATE 2
 SC CONT - SCS
 RHC #2 - unlocked

Primary TVC Check

GMBL MOT PITCH 1 - START - ON
 GMBL MOT YAW 1 - START - ON
 Verify Trim Control & Set
 Verify MTVC
 SCS TVC (2) - AUTO

SCS Only:

THC-CW
 Verify no MTVC
 Secondary TVC Check

GMBL MOT Pitch 2 - START - ON
 GMBL MOT YAW 2 - START - ON
 VERIFY MTVC
 CONFIRM & SET GPI TRIM
 SC CONT - CMC (SCS)
 THC - NEUTRAL
 VERIFY NO MTVC

PRO

ROT CONT PWR NORMAL - 2 AC/DC
 ROT CONT PWR DIRECT (2)-MNA/MNB

ENTR

4 F 50 25

R1 00204 ENABLE ENG. GIMBAL TEST
 (REJECT) ENTR
 (ACCEPT) PRO

If SCS - Null Error Needles
 PROG ALM - TIG Slipped
 *RSET *
 *or V5N9E *
 *KEY RLSE to 5 *

Basic Date Feb. 1, 1969
Changed Feb. 20, 1969

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Basic Date Changed

5 -02:00 06 40 TF GETI, VG, !VM (min-sec, .1fps, .1fps)
 △
 FDAI SCALE - 5/5
 LIMIT CYCLE - OFF
 UPDATE DET
 △V THRUST A - NORMAL
 HAND CONTROLLERS - armed
 CB SPS P2&Y2 - open (CRIT BURNS)
 -00:35 DSKY clears

-00:30 06 40 Ave g on
 TAPE RCDR - RECORD/HBR/FWD
 CHECK PIPA BIAS < 2 FPS in 5 sec
 EMS MODE - AUTO

PERFORM ULLAGE (if req)
 (BACKUP) DIRECT ULLAGE pb
 CONTROL ATT w/RHC
 MONITOR AVM COUNTING UP

6 -00:05 F 99 40 ENG ON ENABLE
 (AUTO) PRO (IGN WHEN TFI <:00 sec)
 (BYPASS) ENTR to 9

7 00:00 IF SCS, THRUST ON pb - push for ignition

IGN 06 40 TFC, AVG, AVM (min-sec, .1fps, .1fps)
 *SPS THRUST FAIL: *
 *F 97 40 TFC, VG, AVM *
 *(RESTART) ENTR to 6 *
 *(CONTINUE) PRO *
 *Poss Prog ALARM *
 *Key V05 N09E *
 * 01407 (VG increasing)*
 *TERM or MTVC *

P40

SPS THRUST 1t - on
 Monitor thrusting:
 $P_c = 95-105$ psia
 SPS ENG INJ v1vs - OPEN
 SPS He v1v tb(2)-gray
 SPS FUEL & OXID PRESS-170-195 psia

TIG + 00:03 ΔV THRUST B - NORMAL

ECO

8 F 16 40 TFC(STATIC), VG, ΔV M (min-sec,.1fps,.1fps)

ECO+1 sec ΔV THRUST (2) -OFF

VERIFY ALL THRUST OFF CUES

CB SPS P2&Y2 - closed (verify)

GMBL MOTS(4)-OFF

TVC SERVO PWR 1&2 -OFF

MN BUS TIES (2)-OFF

ATT DB-MAX

RATE - HIGH

SC CONT - SCS

ECO+10 sec

TAPE RCDR-OFF (tb-bp)

PRO

9 F 16 85 ΔV G XYZ (.1fps)

(A/C or B/D ROLL - ON)

NULL OUT VG COMPONENTS

EMS MODE - STBY

GIVE GROUND RESIDUALS

RECORD ΔV COUNTER

PRO

BMAG MODE - RATE 2

10 F 37

Key 00E

EMS FUNC - OFF

HAND CONTROLLERS - locked

THC PWR - OFF

V82E

11 F 16 44

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

IF HP<49.4 R3= -59B59

PRO

M 104

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Basic Date Changed

P41 - RCS THRUST

CMC - on (Req)

ISS - on and aligned (Reg)

SCS - on (Reg)

TEST C/W LAMPS

LOAD & ACTIVATE DAP

SET DET

EMS ΔV TEST - 1586.8

| | | | |
|-----------------------|---|------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Basic Date Changed | 1 | V37E 41E | |
| | 2 | F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (AUTO) BMAG MODE (3)-RATE 2 PRO (MAN) ENTR to 3 | (.01°) |
| | 2 | 06 18 AUTO MNVR TO FDAI RPY ANGLES | (.01°) |
| | 3 | F 50 18 ATT TRIM ENABLE RPY ALIGN SC in ROLL ENTR to 4 PRO (TRIM to 2) | (.01°) |
| | 4 | 06 85 VGX,VGY,VGZ CHECK BORESIGHT STAR (COAS & OPTICS) MAN ATT (3) - RATE CMD ATT DB - MIN RATE - LOW -00:35 DSKY BLANKS | (.1fps) |
| | | -00:30 TRANS CONT PWR - ON BMAG MODE (3) - ATT1/RATE 2 | |
| | 5 | 16 85 VG XYZ (Ave g on) HAND CONTROLLERS - armed LIMIT CYCLE - OFF TAPE RCDR - RCD/HBR/FWD EMS FUNCT - ΔV EMS MODE - AUTO | (.1fps) |

P41,47

00:00

6 F 16 85 VG XYZ (.1fps)

NULL OUT COMPONENTS

BURN COMPLETE

PRO

EMS FUNC - OFF

EMS MODE - STBY

RECORD ΔV COUNTER/COMPONENTS
TAPE RCDR -OFF (tb-bp)

TRANS CONTR PWR - OFF

THC - neutral, locked

7 F37 KEY 00E

V82E

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

PRO

P47-THRUST MONITOR

CMC - ON

ISS - ON & ALIGNED

G/N PWR OPTICS - OFF

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

Basic Date Feb. 1, 1969
 Changed Feb. 20, 1969

CSM 104

SECTION 7, 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

Basic Date
Changed

CSM 104

- 1 V37E 51E
 F 50 25 00015 MNVR TO ACQ STARS
 (Coarse Align IMU To 0,0,0) - ENTR to 2
 (BYPASS) PRO to 3
- 2 41 22 DESIRED GIMBAL ANGLES (0,0,0)
 NO ATT 1t - on then off, to 1
- 3 F 51 PLEASE MARK
 OPT ZERO - OFF
 MARK
- 4 F 50 25 00016 TERMINATE MARKS
 PRO
- 5 F 01 71 000DE STAR CODE
 Load desired code
 PRO to 3 after 1st MARK (to 6 if DE=00)
 to 7 after 2nd MARK (to 6 if DE=00)
- 6 F 06 88 CELESTIAL BODY VECTOR
 Load desired vector
 PRO to 3 after 1st MARK
 to 7 after 2nd MARK
- 7 F 06 05 STAR ANGLE DIFFERENCE (.01°)
 (RECYCLE) V32E to 1
 (ACCEPT) PRO
- 8 F 37 52E-bypass ZERO OPTICS
 or XXE-OPT ZERO - ZERO

P52

P52 IMU REALIGN

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

- 1 V37E 52E
- 1 F 04 06 R1 00001 IMU ALIGN OPTION
 R2 00001 PREF PRO to 4
 2 NOM PRO to 2
 3 REFSMMAT PRO to 5
 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 NO ATT lt - on then off
- 5 F 50 25 00015 STAR SELECT
 (MNVR If Necessary)
 (PICAPAR) PRO
 *F 05 09 00405 NO PAIR *
 (CREW SPECIFY) PRO - to 6
 *(PICAPAR) V32E to 5 *
- 6 (MAN ACQ) ENTR
- 6 F 01 70 000DE STAR CODE
 Load desired code
 OPT MODE - CMC (verify)

Basic Date Feb. 1, 1969
 Changed _____

CSM 104

OPT ZERO - OFF

PRO to 8 (to 7 if DE=00)

F 05 09 00404 (TA>90°)

*MNVR - PRO To 8 *

7 F 06 88 CELESTIAL BODY VECTOR
Load desired vector
PRO

F 05 09 00404 (TA>90°)

*MNVR - PRO To 8 *

8 06 92 SHAFT, TRUN (.01°,.001°)
PROG ALARM (TA>50°)
*V5N9E 00407 *
*KEY RLSE *
*MNVR till R2<49775 *

(MARK ROUTINE) OPTICS MODE - MAN

- Basic Date
Changed
- Feb. 1, 1969
- 9 F 51 PLEASE MARK
MARK
- 10 F 50 25 00016 TERMINATE MARKS
PRO
- 11 F 01 71 000DE STAR CODE
Load code (if necessary)
PRO to 6 after 1st MARK (to 12 if DE=00)
to 13 after 2nd MARK (to 12 if DE=00)
- 12 F 06 88 CELESTIAL BODY VECTOR
Load vector
PRO to 6 after 1st MARK
to 13 after 2nd MARK
- 13 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(REJECT) V32E to 15
(ACCEPT) PRO
- 14 F 06 93 TORQUING ANGLES OG, IG, MG (.001°)
(TORQUE) PRO (CMC - FREE)
(BYPASS) V32E

P52,53
F 50 25 00014 ALIGNMENT CHECK
(RECHECK) PRO To 5
(BYPASS)
ENTR

16 F 37 XXE OPT ZERO - ZERO

P53 - BACKUP IMU ORIENT DETERMINATION

CMC - on
ISS - on
SCS - operating
MAN ATT (3) - MIN IMP
COAS LOS DETERMINATION - complete
pg CMP/3-11

1

F 50 25 00015 MNVR To ACQ STARS
Coarse Align IMU to 0,0,0) - ENTER to
(BYPASS) 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 (Do not PRO - Recovery, Reselect prog)

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

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CSP 104

PRO to 3 after 1st MARK
to 8 after 2nd MARK

- 8 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(RECYCLE) V32E to 1
(ACCEPT) PRO
- 9 F 37 XXE

P54 - BACKUP IMU REALIGN

CMC - on

ISS - on

SCS - operating

MAN ATT (3) - MIN IMP

COAS LOS DETERMINATION - complete
pg CMP/3-11

Basic Date
Changed
Feb. 20, 1969

- 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 5
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 - NO ATT 1t - on then off
- 5 F 50 25 00015 STAR SELECT
(Mnvr If Necessary)
(PICAPAR) PRO

CSM 104

*F 05 09 00405 NO PAIR *
(CREW SPECIFY) PRO to 6
*(PICAPAR) V32E to 5 *

(MAN ACQ) ENTR

- 6 F 01 70 OCODE STAR CODE
Load desired code
PRO to 8 (to 7 if DE=00)
- 7 F 06 88 CELESTIAL BODY VECTOR
Load desired vector
PRO
- 8 F 06 94 ALT LOS OPT ANGS SHAFT, TRUN(.01°,.001°)
Load angles
PRO
- 9 F 53 PLEASE MARK
Center Target
ENTR (Do not PRO - Recovery, Reselect pro
- 10 F 50 25 00016 TERMINATE MARKS
(REJECT) ENTR to 9
PRO
- 11 F 01 71 00ODE STAR CODE
Load code (if necessary)
PRO to 6 after 1st MARK (to 12 if DE=00)
to 13 after 2nd MARK (to 12 if DE=00)
- 12 F 06 88 CELESTIAL BODY VECTOR
Load vector
PRO to 6 after 1st MARK
to 13 after 2nd MARK
- 13 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(REJECT) V32E to 15
(ACCEPT) PRO

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Changed

CMP
7-7/8

P54

- 14 F 06 93 TORQUING ANGLES OG, IG, MG (.001°)
(TORQUE) PRO
(BYPASS) V32E
- 15 F 50 25 00014 ALIGNMENT CHECK
(RECHECK) PRO to 5
(BYPASS) ENTR
- 16 F 37 XXE

Basic Date Feb. 1, 1969
Changed Feb 20, 1969

CSM 104

CMP
8-1

SECTION 8. SCS

GDC ALIGNMENT TO IMU GIMBAL ANGLES

- 1 IMU - ON (Req)
SCS - ON (Req)

2 ESTAB SCS ATT HOLD IN TIGHT DB

3 ATT SET dials - set to IMU angles on
FDAAI 1

FDAAI SELECT - 1

FDAAI SOURCE - ATT SET

ATT SET - IMU

ATT SET dials - null FDAAI 1 error
needles

ATT SET - GDC

GDC ALIGN pb - push until needles
nullled

SCS ATTITUDE REFERENCE COMPARISON

- 1 CMC - ON (Req)
IMU - ON (Req)
SCS - ON (Req)
SIVB SEPARATED:
ESTAB SCS ATT HOLD IN TIGHT DB

2 Key V37E00E
Key V16 N20E, (pres Δ IMU angs)

3 FDAI SELECT - 1
FDIA SOURCE - ATT SET
ATT SET - GDC
ATT SET dials - null FDAI 1 error
needles
Key V (when nulled to freeze display)
RECORD FROM DSKY:
VBB N20 R, P, Y (DEG)
R= ____°, P= ____°, Y= ____°
ATT SET dials (3) - Record
R= ____°, P= ____°, Y= ____°

4 Key V37E 00E

8.
SCS

CMP

8-2

BACKUP GDC AND/OR IMU ALIGNMENT

SCS - ON (Req)

CMC - OFF or STANDBY

RECORD: R, P, Y ALIGN from MSFN

1 SCT, SHFT - 180, TRUN - 7.5

2 ATT SET DIALS - R, P, Y ALIGN
FDAI SELECT - 1/2

3 MNVR To STARS:
ACRUX (No. 25) on 50° MARK
ATRIA (No. 34) on R Line in SCT

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

5 ATT SET dials - 0,0,0 or 180,180,0

6 MNVR SC to ΔV attitude on GDC Ball &
null error needles

7 Perform SXT/STAR check and adjust
in pitch and yaw if necessary

8 FDAI SELECT - 1/2
Cage IMU
Uncage IMU (When IMU is 0,0,0)

PGNS ORDEAL INITIALIZATION

1 FDAI 1 or 2 - ORB RAT

EARTH/LUNAR - EARTH

2 V82E
F 04 12 R1 00002 SPECIFY VEHICLE
R2 1E (CSM)
PRO

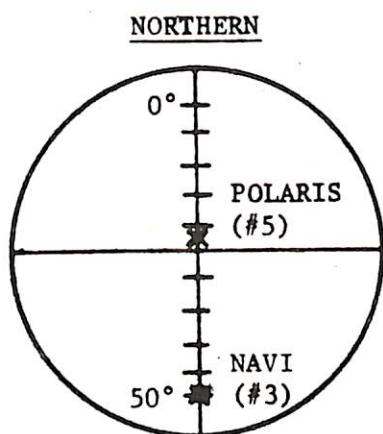
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CMP
8-3

- 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

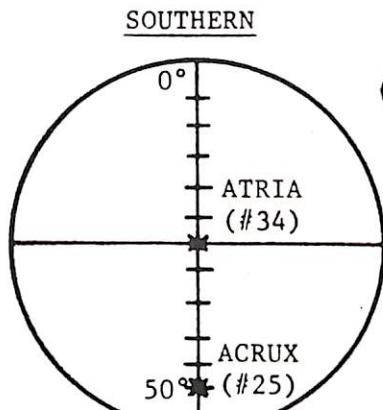
SCS ORDEAL INITIALIZATION

- Basic Date Feb. 1, 1969
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- 1 FDAI 1 or 2 - ORB RATE
EARTH/LUNAR - EARTH
- 2 MSFN Supply Altitude
ALT SET - Set
- 3 SC INPLANE (0° YAW) (DES)
(GDC INPLANE ALIGNMENT REQ)
SC +X At the Horizon
- 4 MODE - HOLD/FAST
Slew FDAI
MODE - OPR/SLOW

Basic Date Feb. 1, 1969
Changed _____SHFT 180° TRUN 7.5°

REFS _____
R _____
P _____
Y _____

REFS _____
R _____
P _____
Y _____

SHFT 180° TRUN 7.5°

REFS _____
R _____
P _____
Y _____

REFS _____
R _____
P _____
Y _____

SECTION 9. LM INTERFACE

1. PRE IVT UNSTOWAGE (S: Systems, E: EVA, R: Rndz)

| <u>DAY</u> | <u>FROM</u> | <u>UNSTOW</u> | <u>TRANSFER TO</u> |
|------------|-------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| LEB | LEB | 1. Optics 2. Rad Survey Meter | Optics Stowage F-2 |
| E | R-13 R-3 R-13 | 1. H-Blad Handles (2) 2. R-12 3. ISA | F-2(ISA) F-1 Right Girth Ring F-2 |
| SER | A-8 | 1. EVA Utility Bag with: a. Open Jackscrews b. Tool B 2. Tool Tether 3. MDC Bars | Beneath -Z girth shelf |
| SER | | 2. Tool Tether 3. MDC Bars | F-1 MDC |
| ES | A-7 | 1. SWA 2. SWA MAG (E) 3. 70mm Mag 4. 70mm Mag (A) | F-s(ISA) F-2(ISA) F-2(ISA) F-1 |
| E | A-5 | 1. EVA Gloves | Helmet bag, IV gloves to A-5 Helmet Bag to beneath right couch |
| E | | 2. Remote Cable (LM) | F-2(ISA) |
| E | R-10 | 1. Remote Cable (CM) | F-1 |
| SER | | 2. Seq. Bracket | F-1 |
| E | | 3. Hatch Bracket | F-1 |
| SER | R-6 | 1. Probe Straps (2) | Right seat pan, hook to D-rings |
| E(R) | B-3 | 1. 5mm Lens (18mm) | F-2(ISA) |
| ER | | 2. Seq. Camera | F-1 |

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9. LM INTERFACE

| | | | |
|-------------------|-------|-------------------------------------------------|-----------------------------------------------------------|
| E(R) | | 3. 5mm Lens (18mm) | F-1 |
| ER | | 4. Power Cable | F-1 |
| ER | | 5. H-Blad | F-1 |
| | | Spotmeter | F-1 |
| ER | B-8 | 1. Seq. Camera | F-2 (ISA) |
| ER | | 2. 2 16mm Mags (P)(R) | F-2 (ISA) |
| ER | | 3. 2 16mm Mags (J)(K) | F-1 |
| SER | A-1 | 1. Umbilical Inter-connects (2) | Strap on R-10 |
| E | | 2. Thermal Samp Tether | L-3 large hook <i>(SAMPLE)</i> end to L-3 hand-hold |
| ER | | 3. TSB | Left Girth Ring |
| ER | U-3 | 1. Seq. Bracket | F-2 (ISA) |
| SR | | 2. Docking Target | Right Window |
| SER | L-Bag | 1. Couch Straps | Right Couch y-y strut |
| S(E)R R | — | 2. Helmet Shield D-meter | (CDR) CMP Helmet Mount above left girth |
| R | — | Bracket, D-Meter Checklists, clips | Above left girth R-12 |
| SER | R-5 | 1. Utility Strap | Hatch Bag, open hatch bag |
| | A-5 | 2. Helmet Bags | L-Bag |
| LMP <u>A-8</u> | | All Loose Equipment EMU Maint Kit Antifog | <i>R</i> 5-8 F-1 |

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2. IVT (Systems and EVA Days)

Couches: CDR- 0°, CMP- 0°, LMP- 180°

Don helmet protective shield

Verify suit integrity

TUNL LTS - ON

LM TUNL VENT vlv - LM/CMP ΔP

Verify LM/CM ΔP < 0.2

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

x LM/CM ΔP > 0.2 x

x Equalize CM/TUNL Pressure x

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Remove tunnel hatch

(3)

Remove docking probe

(4)

Remove docking drogue

(5)

Pull LM hatch vlv to equalize TUNL/CM pressure

Open LM hatch

Crew Transfer

(6)

Install drogue

(8)

Install probe

(9)

Install tunnel hatch

(11)

LM TUNL VENT vlv - LM PRESS

Remove center couch and stow (LM Manned Only)

Configure side hatch for EVT (LM Manned Only)

ACTR handle sel - N (neutral)

GN2 vlv handle - pull (inboard)

GN2 Press ind. - minimum

3. TUNNEL HATCH REMOVAL

PRESS EQUAL vlv - OPEN (CCW)

(F)

PUMP HANDLE - unstow, pull to stop, set to U (A)
- Push to stop

Verify gearbox disconnect socket - U

PUMP HANDLE sel - stow

- push hndl to stow

Remove hatch, stow

4. PROBE REMOVAL (CM Side)Verify Extend Latch engaged indicator (RED)
not visibleBasic Date Feb. 20, 1969
Changed

COM 104

- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 x Extend latch not engaged: x
 x PRELOAD SEL LEVER - rotate CW(away from x
 x orange stripe) x
 x PRELOAD HANDLE - Torque CCW to engage x
 x extend latch (red ind. not visible) x
 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- TLD GN2 BLEED button (RED) - press (10 sec)
 PRELOAD SEL LEVER-rotate ccw(parallel to
 "orange stripe")
 PRELOAD HANDLE - Torque (CW) unload support
 beams
- LOD PRELOAD SEL LEVER-rotate cw(away from orange
 stripe)
 PRELOAD HANDLE- torque CCW to engage extend
 latch (red indicator not visible)
 GN2 BLEED button (RED) - press (10 sec)
- PROBE UMBILICALS (2) (Yellow) - disconnect and
 stow
 Elec. connector covers (2) (yellow) - close
 PRELOAD HANDLE - 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 HANDLE - unstow to full extension
 - push to first detent (red
 band)
 - push outboard and hold to (F)
 fold probe
- RATCHET HANDLE - pull to full extension
 - ratchet probe one stroke
 only

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CSJ4

Restow RATCHET HANDLE and INSTALLATION STRUT

CAPTURE LATCH RLSE HANDL - Pull, rotate To Unlock
 (180° CW)
 - push to recess

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 x Capture latches will not release: x
 x Ratchet probe forward x
 x Preload probe until latches release x
 x Remove probe by above procedure x
 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Remove PROBE - pull aft to release (25 lbs)

5. DROGUE REMOVAL

DROGUE LOCK LEVER - Pull, rotate 90° CCW

DROGUE - rotate CW, push clear of support
 - remove from tunnel

6. CREW TRANSFER

LMP Transfer To LM

DOCK TUNNEL INDEX ANGLE

Actuate CABIN DUMP VALVE and open hatch

FLOOD LIGHT - ALL, EXT LTG - OFF

DES H2O - OPEN

Perform ENTRY STATUS CHECK, EPS, GLYCOL, C/W
 CB, TB, ECS, and VHF checks

CMP Load ISA

Transfer ISA To LM

Receive EVVA from LMP, stow in helmet bag
 from A-5 on right LEB

When LMP ready - LMP SUIT FLOW - OFF

Panel 6 POWER-OFF, SUIT POWER-OFF

Retrieve LMP umbilical, interconnect and stow

Panel 9 POWER-OFF, SUIT POWER-OFF

CDR SUIT FLOW - OFF

CDR disconnect, Transfer To LM

Interconnect CDR Umbilical and stow

Stow helmet on right LEB

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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 F1 or F2

8. INSTALL DROGUE

DROGUE - Align Lugs with fittings
 - Rotate CCW to stops
 LOCK LEVER - Rotate 90° CW to detent

9. INSTALL PROBE

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 detent

Verify capture latches engaged (CDR)

INSTALLATION STRUT - unstow, position on tunnel
 wall (yellow marks)

RATCHET HANDLE - unstow to full extension (green
 band)
 - ratchet probe fwd to orange hash
 mk

Restow RATCHET HNDL & INSTALLATION STRUT

CAUTION

For stowage - adjust PRELOAD HANDLE until
 probe loose in tunnel and position at 45°
 to support beam

CONTINUED PG CMP/9-9 (TOP)

10. PRELOAD PROBE

Preload Set Lever - rotate CCW (parallel to orange
 stripe)

PRELOAD HANDLE - torque (CW) to release
 Verify capture latches engaged (CDR) (G)

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PRELOAD HANDLE - push inboard to detent, position 45°
to support beam

PRELOAD SEL LEVER - mid position

Verify CAPTURE LATCH RLSE HNDL LOCK is locked (orange stripe not visible)

11. HATCH INSTALLATION

Align Hatch in tunnel

PUMP HANDLE - unstow, set to L
- push to stop

(C)

Verify gearbox disconnect socket - L

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

PUMP HANDL sel - stow, push hndl to stow

HATCH PRESS EQUAL vlv - closed (CW)

(D)

12. HATCH INTEGRITY CHECK

Verify LM Hatch Closed, Dump Valve - Auto (CDR)

Verify CABIN PRESS ind - 4.8-5.2 psi

TUNL VENT vlv - TUNL VENT for 30 sec

- LM/CM ΔP, check ΔP

- Recycle to TUNL VENT until ΔP > 3.0

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

- x Cannot vent tunnel: x
- x If O2 FLOW ind. increases, open hatch, x
- x wipe seal surfaces, close hatch x
- x If O2 FLOW ind does not increase, dump x
- x tunnel through LM x

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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

VALUE

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Verify O2 flow ind - no increase
 LM TUNL VENT vlv - OFF
 TUNNEL LIGHTS - OFF

~~13.~~ SEPARATION

~~CB DOCK PROBE (2) - closed~~
~~Verify status with LM~~
~~Maneuver to sep attitude~~
~~DET - set~~
~~DET RSET - DOWN~~
~~DET START - START (on signal from CDR)~~
~~PROBE EXTD/REL - EXTD/REL~~
~~(hold for full probe extension~~
~~but not more than 20 sec)~~
~~PROBE EXTD/REL tb (2) - gray to bp to gray~~
~~Monitor vehicle motions~~
~~PROBE RETR PRIM - 2~~
~~PROBE RETR SEC - 1~~
~~EXT RUN/EVA LT - on (up) (verify)~~
~~EXT RNDZ LT - RNDZ (verify)~~

~~14.~~ STATIONKEEPING

~~SC CONT - SCS, CMC MODE FREE~~
~~Establish wings level attitude held min deadband~~
~~Roll left 60° for LM active docking~~
~~CB DOCK PROBE(2) - close~~
~~CB SECS ARM(2) - close~~
~~After MSFN AOS~~
~~SECS LOGIC(2) - on (up)~~
~~AFTER MSFN GO:~~
~~SECS PYRO ARM(2) - on (up)~~
~~PROBE EXTD/REL - RETRACT~~
~~PROBE EXTD/REL tb(2) - gray~~
~~PROBE RETR SEC - 1~~

~~15.~~ LM DOCKING (or CSM DOCKING)

~~At Captive: PROBE EXTD/REL tb-bp~~
~~SC CONT - CMC~~

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

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Verify ratchet pawl indicator(red) flush with housing

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xRatchet pawl indicator not flush:

Hold RATCHET HANDLE full outboard

Press Pawl indicator to seat (flush)

x Release RATCHET HANDLE

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Prelod Shaft - push in to detent

CAPTURE LATCH RLSE HNDL - Set in detent

CAPTURE LATCH RLSE HNDL LOCK - rotate CW to lock

PROBLE UMBILICALS (2) (yellow)-connect to dock ring

NOTE: for stowage, umbilical connection not required

~~Close Tunnel Hatch~~

~~Instant Tunnel Hatch~~

~~Perform Hatch Integrity Check~~

~~CB SECs ARM (2) - close~~

~~M8 FN AOS: SECs LOGIC(2) - on (up)~~

~~MSFN GO: SECs PYRO ARM (2) - on (up)~~

~~CSM/LM FINAL SEP (2) - on (.4 fps sep)~~

~~SECs PYRO ARM (2) - SAFE~~

~~SECs LOGIC (2) - OFF~~

~~CB SECs ARM (2) - open~~

~~17. POST JETT SEP MANEUVER~~

~~Jettison LM @ 101:30 OVER GWM
R-0, P-13, Y-135 (L/W)
Flyover LM (keep Boresighted)
Until CSM Is At SEP Attitude
R-132.9, P-105.8, Y-23.5 (Inertial)
Fly Formation Until SEP TIG.
Separate From LM @ 101:38:14.
(APS TIG -20)
4 Jet -X Translation
 $\Delta V = 2.0$ fps
APS Ignition @ 101:58:14
CSM/LM Range - 3500 ft.~~

~~18. MALFUNCTION LIST~~~~Tunnel Hatch~~

- A. Can not Remove Tunnel Hatch
 - Use Tools E and R To Remove (3) Gearbox Mounting Screws (Torque-Set Heads) with spacers
 - Unstow ACTR Handle And Rotate Away from Hatch Approx. 30°
 - Push ACTR Handle Outboard Rotating Gearbox Approx. 40° CCW To Release Latches.
 - Use Procedure B For Re-installation
 - Remove hatch from tunnel
 - Rotate Gearbox Disconnect 180° ccw using tool B.
 - Rotate gearbox approx. 40° cw and re-install (3) gearbox mounting screws
 - Re-install hatch using x-list backup procedure

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- C. Cannot Re-install Tunnel Hatch (Frozen Latch)
 - Use Tools E, R And F With the Slot Tip From Supplemental Tool Kit And Remove Dome Nuts (2) From The Long Pivot Screws Of The Frozen Latch.
 - Remove The Long Pivot Screws And Rotate The Latch Dog To Clear Striker Plate.
 - Re-install Hatch With Normal Procedure.
- D. Pressure Equalization Valve Will Not Close.
 - Remove Hatch
 - Use Tool B In External Tool Interface For Additional Leverage
- E. Pressure Equalization Valve Will Not Open For TLD:
 - Vent CM
 - Perform Tunnel Operations
 - Repress CM
 - For Systems Day And Subsequent:
 - LM Tunnel Vent vlv - LM PRESS (Will Require At Least 12 hrs. To Equalize Pressure)

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PROBE

- F. Cannot Fold Probe To Remove From Tunnel
(Crewmen In LM Only)
- Remove Drogue From LM Side
 - Connect Probe Umbilicals (2) (yellow)
 - CB Dock Probe (2) - Close
 - Probe Extd/Rel - Extd /Rel For 20 Sec Max.
 - Verify Probe Extension
 - cb Dock Probe (2) - Open
 - Using Tools From Supplemental Tool Kit And Tool F, Remove Nut And Bolt From Either End Of (3) Shock Struts.
 - Fold Support Beams By Pulling Probe Toward CM.
 - Disconnect Probe Umbilicals (2) (Yellow) And Remove Probe From Tunnel.
- G. 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)

DOCKING LATCHES

- H. Cannot Cock Docking Latch By Pulling Handle
- Depress Aft End Of RH No-Back Pawl While Pulling On Latch Handle.

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- If unsuccessful, Use Tools E And R To Remove Fairing To Left Of Latch Handle, (2) Screws
- Depress Aft End Of Both (2) - No-Back Pawls While Pulling On Latch Handle

Tunnel

- J. High O2 Flow While Cocking Docking Latches
- Use Tool F To Drive Hex Fitting On Aft End Of Preload Shaft (CW Direction, 30 to 40 lbs. On Tool Handle).

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).

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