"F" NOTES

The numbering convention for the program notes is X.X.X, where:

A. First digit

1 = Crew notes and checklist items - These are notes being of particular interest to the crew.

2 = Ground notes - These are notes being of particular interest to mission operational and planning people.

3 = Restarts and priorities

B. Second digit

1 = Nouns, verbs, displays

2 = Selection of new programs and extended verbs

3 = Ground updates and pad loads

4 = Navigation and W-matrix

5 = Rendezvous and targeting

6 = Optics, IMU, and radars

7 = Guidance and control, boost, and entry

C. Last digit, order number

ENCLOSURE

Section A

Program and procedure notes applicable to the F mission.

1. Crew Notes and Checklist Items

1.1 Nouns, Verbs, and Displays

1.1.1 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, 35, 41, 72, 97, 98.

1.1.2 The following nouns can never be loaded via V24 or V25: 40, 44, 45, 50, 63, 80.

1.1.3 There are three priority displays in COLOSSUS which will ignore any response for two seconds:

V06N49 in R22
V05N09 in R52
V50N18 in R60 during P20

1.1.4 NOUN 81 in P30 should not be loaded with less than .2 PPS

If P30 is used to determine by loading N81 with zeros, do not proceed on N42, rather V37E00E

Section A

1.2 Selection of New Programs and Extended Verbs

1.2.1 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.

1.2.2 During periods of high computer activity, e.g., P11, P4X with Lambert, or P20 with a targeting program, the selection of certain extended verbs (notably V82, V83, V85, V90) may result in program alarms 1201 or 1202 and extended verb activity is lost. Recovery procedure: Reselect extended verb.

1.2.3 If an extended verb has been selected during a mission program, with normal displays, the extended verb logic initially blanks the DSKY. Any response during the time the DSKY is blank would do one of the following things: a) respond to a normal mission program display underneath the extended verb; b) respond to the first display in the extended verb which could be initiated simultaneously with your response.

1.2.4 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.

b) P40/P41 - P27 - P52

Problem: P27 overwrites preferred computation. Recovery procedure: Redo P40/P41 up to V50N18, then reselect P52.

1.2.5 V35 Restrictions: 1) In prelaunch do not use V35 during gyrocompassing; 2) After launch use V35 only in P00. Ten seconds should be allowed before the PIPA's are used; hit error reset to clear fail registers.

1.2.6 Depending upon intial gimbal angles, the VECPOINT routine may result in large computed rotations about the pointing vector when the pointing vector must be rotated through about 180° (an example of this would be in P40 or P41. If the +X axis were about 180° away from the thrust vector, the V50N18 may display a large change in outer gimbal angle.) Recovery procedure: If the computed attitude is acceptable then simply proceed with the maneuver. If it is not, then manually maneuver in pitch and have the solution recomputed after some 20-to-30 degrees by keying

Section A

PRO on V50N18 while not in CMC and AUTO.

~~1.2.7 Use V30 and V31 only in P00.~~

1.2.8 Any program can be terminated: 1) at any flashing display via V34E; 2) at any flashing or non-flashing display via V37EXXE with the following restrictions: (1) only a V37E00E is allowed after separation (PROCEED on V25N50 - 00041 in P62); ~~(2) V34E is not allowed on a flashing V51 in P22 until at least one mark is taken.~~

1.2.9 Select P00 after using V96 to terminate all integration of the state vectors. If the integration being done is for P20 processing or ~~P22~~ during exit of P41 (after response to V37 flashing) key in V93 after selecting P00.

1.2.7 If V30 or V31 are entered into DSKY, an indeterminate program transfer may result because their verbs use constants of N26. N26 variables are overwritten with other

1.2.10 V82 may give erroneous results during Venus launch or trans-earth coast phases since its computation are based on 2 body conic equations

avoidance procedure: do load N26 and use V30 & V31 only in P00

Section A

1.3 Ground Updates and Pad Loads

None

Section A

1.4 Navigation and W-matrix

1.4.1 Taking marks on a landmark in the vicinity of the horizon and identifying the landmark as an unknown landmark, may cause either of the following to occur:

a) square root abort, termination of P22, and return to P00. Recovery procedure: Reselect P22.

b) overflow in the initialization of the landmark portion of the W-matrix, resulting in erroneous navigation calculations. Recognition of this effect is difficult. Recovery procedure (if recognized): Reject update on ΔRΔV display. Avoidance procedure: Do not use unknown landmark option of P22 for landmarks near the norizon. NOTE: It is recommended that all landmark sightings (known or unknown) be made such that the angle between the CSM-to-landmark LOS and the local vertical is less than 45 degrees.

1.4.2 The range and range rate displays (in R31 and R34) may degrade considerably at ranges below 0.3-0.5 NM depending on marking schedules and resultant AGC navigation accuracy.

1.4.3 In lunar environment, velocity and flight path angle are incorrect in N73 associated with P21. Recovery procedure: Divide velocity display by 4 to get true result. Multiply flight path angle by 4 to get true results (for small angles $\approx 5^{o}$). See also anomaly report COM 1.

1.4.4 If V56 (terminate P20) is keyed in during a computation in P34-P35, these computations will be restated from the beginning.

Section A

1.5 Rendezvous and Targeting

1.5.1 To ensure processing of the last mark in P20, wait until the computer activity light goes on before proceeding. The light indicates the previous mark is being processed. If PROCEED is done too soon, one of the last two marks may be ignored.

1.5.2 P38 Stable Orbit program, operating in mode 1, only computes TFINAL on initial entry of the program. It is not recomputed on each recycle or proceed from V16N45. To have TFINAL recomputed, reselect P38.

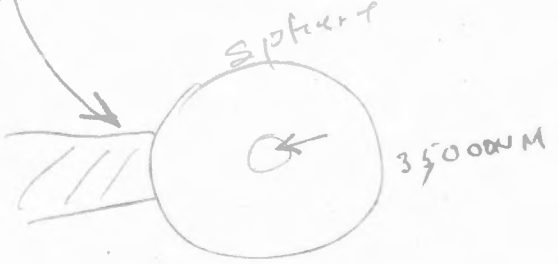
1.5.3 P37 targeted maneuvers from earth parking orbit will yield transfer times on the order of two minutes for the portion of the premaneuver orbit from apogee to perigee target line built into the program. When the premaneuver orbit is highly circular with poorly defined apogee and perigee, the short transfer time will occur whenever the flight path angle is negative.

1.5.4 All uplinked or keyed in ΔV's and target vectors must be in the same sphere of influence as the AGC determined state at TIG and TIG-30.

1.5.5 V83 and V85 displays will be meaningless at altitudes greater than 425 NM for both earth and moon if these verbs are exercised during periods of precision state vector integration.

1.5.6 Provided that the time of ignition, TIG, is defined to occur outside the lunar sphere of influence, P37 will always produce a conic solution although no precision solution may be possible.

1.5.7 For pre-apogee, long transit time abort, the conic solutions in P37 may be grossly inaccurate yielding erroneous landing site coordinate displays. In addition, long integration period of perhaps 10 - 30 minutes may be experienced.



Section A

1.6 Optics and IMU

1.6.1 After a fresh start, or restart, or after turning optics power on, the optics must be taken out of zero and returned to perform an optics zero since it is not the position of the switch but the change to the zero position that triggers the zeroing program.

1.6.2 If the mode switch is in CMC and AUTO or HOLD mode during R55 (gyro torquing routine) or during V42, the DAP will maneuver the vehicle to follow the platform as it moves.

1.6.3 If a PROCEED response is made to V53 flashing in P53 and P54, the program hangs up as a sleeping job. Avoidance procedure: Do not proceed on V53 flashing in P53 and P54. Recovery procedure: Reselect P53 or P54 again. See also anomaly COM 3.

Section A

1.7 Guidance and Control, Boost, and Entry

1.7.1 During the trimming of Lambert derived $\underline{v}_G$, the v_G display may jump in earth environment, 0.1 - 0.2 ft/sec at transfer of 140°, 0.3 - 0.5 ft/sec at transfer of 60°, and 0.5 - 1 ft/sec at transfer of 30°. For moon environment these jump numbers are 0.02, 0.05, and 0.1, respectively. Recovery procedure: For transfer angle of 140° trim to 0.3 ft/sec. For transfer angle of 60° trim to 0.5 ft/sec. For transfer angle of 30° trim to 1.0 ft/sec.

1.7.2 During TVC control (in P40), astronaut use of the DSKY will mask possible V97 display (thrust fail display). Avoidance procedure: Do not allow extended verb, monitor or static displays to occupy DSKY for long periods of time during TVC.

1.7.3 Following a hybrid deorbit burn with long coast times, the time to 0.05g's, TFE, will be in error by up to four minutes, depending on how early after the deorbit maneuver P61 is called.

1.7.4 Because of the 0.01-second time granularity in the AGC, the calculation of small Lambert maneuvers may differ considerably from ground computations. The immediate effect, e.g., in P41, will be a different set of desired gimbal angles from those expected on the ground. The angular difference between the ground and AGC $\underline{v}_G$'s is a function of earth or moon environment, the magnitude of $\underline{v}_G$, and the active vehicle transfer angle. For 1 ft/sec maneuvers, this angular "error" could vary from $\sim 5^\circ$ (at 140° transfer) to $\sim 20^\circ$ (at 60° transfer) to $\sim 30^\circ$ (at 30° transfer) for the earth. For the moon, these angles are $\sim 1^\circ$, $\sim 3^\circ$, and $\sim 5^\circ$, respectively. For greater $\underline{v}_G$ the angular error is inversely proportional to the magnitude (approximately). Since the maximum error is 30°, the cross axis velocity introduced by performing the maneuver is $< \pi/6$ ft/sec.

1.7.5 If a roll jet fails "on" during SPS thrust, an appreciable roll excursion ($\approx 30^\circ$) may occur. The PITCH-YAW dap will continue to function properly.

1.7.6 The Down Range Error display (N66) in P67 will be set to 9999.9 NM when the vehicle state "goes past" the target. That is, under these conditions this display will not exhibit negative down range error.

Section A

2. Ground Notes

2.1 Nouns, Verbs, and Displays

2.1.1 See 1.1.2.

Section A

2.2 Selection of New Programs and Extended Verbs

2.2.1 See 1.2.1.

Section A

3. Restart Notes

3.1 Nouns, Verbs, and Displays

3.1.1 If a POODOO alarm (1206, 1210, 1302, 1501, 1502, 1103, 1601, 1521, 1204, 1103, 403, 607, 610) takes place during permanent integration, STATEFLG, REINTFLG, and NODOFLAG are not reset with the result that subsequent integrations will cause difficulties. Avoidance procedure: None. Recovery procedure: Reset REINTFLG, STATEFLG, and NODOFLAG as follows: a) V25N07E
106E
100E
E
b) V25N07E
77E
20E
E
c) then select P00 (V37E00E) which will clear NODOFIG. See also anomaly report COM 2.

Just select P00 - GARMAN

1220 / 1201 / 1301 } alarms

Section B

Program and procedure notes applicable to the F mission.

1. Crew Notes and Checklist Items

1.1 Nouns, Verbs, and Displays

1.1.1 The nouns that can be called at any time with valid data are: 1, 2, 8, 9, 10, 20, 21, 27, 36, 46, 47, 48, 65, 72, R1 of 45, and R2 of 66.

1.1.2 Use of V30 and V31 (astronaut program calls from the DSKY) ~~only in~~ P00 (LNY-31). may cause indef prog transfer other than recovery: reselect program

1.1.3 N42 values of h_a and h_p (in P30) will vary slightly from N44 values of h_a and h_p (in V82). N42 uses conic calculations which are slightly in error for near lunar orbits. N44 biases the computed values closer to the real values. The larger the ΔV used in P30, the greater the error in N42. Recognition: Difference in displays (SDN-131). example

1.1.4 After an illegal monitor verb-noun is executed, the LGC verb register is left containing a display verb rather than the monitor verb remaining in the verb lights (LNY-26). Recognition: Display verb in verb light after illegal monitor verb-noun request. Recovery: Key correct verb-noun combination.

1.1.5 When loading decimal data into the LGC, the ENTER sometimes changes the last digit of the loaded value since PINBALL roundoff in decimal/octal/decimal conversions occurs when data is keyed in (decimal to octal) and entered and redisplayed (octal to decimal).

1.1.6 The program will ignore any attempt to load channel 7 via the DSKY. It will not even alarm. Channel 7 is the superbank indicator and is under exclusive program control.

1.1.7 The $\underline{V}_g$ or $\underline{\Delta}_V$ displays in body axes, N83 or N85, are based on reading the accelerometers every two seconds. The displays, however, are asynchronous one-second monitors. The result is a $\frac{1}{2}$ - $1\frac{1}{2}$ sec delay between application of ΔV and the visible result.

1.1.8 V35 should only be used in P00. ~~DSKY pushbutton~~ ALWAYS use ERROR RESET ~~should be used~~ to clear FAILREGS following the PROG light off. when V35 is used

1.2 Selection of New Programs and Extended Verbs

1.2.1 An infinite loop in coasting integration can occur under the conditions of the extrapolation of faulty state vectors. Recognition: Excessive time to update state vector verified by keying V16N38E (small oscillating time steps). Recovery: V96E to stop integration loop. State vector update may be required.

1.2.2 During periods of high computer activity, the selection of certain extended verbs (notably V82, V83, V90) may result in program alarms 1201 or 1202 and extended verb activity is lost. Recovery: Reselect extended verb.

1.2.3 If an extended verb has been selected during a mission program, with normal displays, the extended verb logic initially blanks the DSKY. Any response during the time the DSKY is blank would do one of the following things: a) respond to a normal mission program display underneath the extended verb; b) respond to the first display in the extended verb which could be initiated simultaneously with your response. In general, do not key a response (PRO, ENTER, V32E, V33E, V34E) to either a blank DSKY or a non-flashing display.

1.2.4 Do not select a mission program via V37 after selecting P20 until the first R60 display in P20 (V50N18 priority display) (SDN-48).

1.2.5 When a new program selection is made via V37, the key release light will remain on during R00 and will not go off until the new program is started. No further keyboard activity should be attempted until the key release light goes off and the new mode lights are displayed.

1.2.6 Do not select V92 during P00. Recognition: 1) 07 appears in program light; 2) the DAP is turned off for 10 seconds; 3) the W-matrix will be zero or overwritten; 4) flashing V06N41. Recovery: Select P00 via V37E00E, key V93.

1.3 Ground Updates and Pad Loads

None

1.4 Navigation and W-matrix

1.4.1 The W-matrix should not be initialized to magnitudes greater than 325 fps and 8.5 NM.

1.4.2 A V96E can cause the W-matrix to be out of phase with the state vectors if it is performed: 1) during P20 mark processing, but only if the CSM state is being updated (V81); or 2) during AVETOMID, i.e., after responding to the FLV37 when leaving a program where Average-G was on and before the program lights change. Recovery: For 1) none needed; 2) V93E.

1.4.3 A P00D00 alarm during permanent integration requires clearing STATFIG and REINTFLAG and selecting P00 (LNY-43). Recognition: Integration processes are lost and V73's are inhibited except to P00. Recovery: V25N7E V25N7E V37E00E
77E 106E
20E,E 100E,E

1.4.4 P20 rendezvous navigation provides a priority display (V06N49) of ΔR and ΔV when the state vector update exceeds the pad-loaded erasable values RMAX and VMAX. ~~Currently there are two problems:~~ 1) If the display is desired before every incorporation, any negative value must be set into RMAX, not zeroes; 2) ΔR is computed as zero if ΔR < 3000 ft and ΔV is computed as zero if ΔV < 3 fps. Avoidance procedure: If it is desired to observe V06N49 for each mark, then RMAX should be loaded as any negative number.

1.4.5 A 520 alarm may occur when V37E 1xE is used during P20 or R04 (V77 or V63). Recovery: ERROR RESET and continue nominally.

1.4.6 The LOS vector to the CSM may be of such magnitude and direction as to cause computation breakdown in the auto Z axis tracking routine. It does not affect navigation in any way. Recognition: 1301 alarm (possibly once every 2 seconds) Recovery: ATT CONT mode sw to HOLD; V76E; Move ACA out of cent detent and release in either pitch or yaw; V77E, ATT CONT MODE sw to AUTO. Continue nominally (LNY 54)

1.5 Rendezvous and Targeting

1.5.1 The scaling of computations in P32 may cause CDH TIG to be in error by 18 seconds (É < .000488)(LNY-29).

1.5.2 Range rate ~~calculation~~ display in V83 may ~~be discontinuous when the range is small~~ degrade considerably (< 1 nmi) (LNY-35).

1.5.3 Lambert computations should not be used within three degrees of a target vector.

at ranges .3 - .5 nm depending on navigation accuracy

1.6 Optics, IMU, and Radars

1.6.1 In all P5X's the permissible values of R1 of N70 and/or N71 are 0-508 for the star code. Anything else will cause indeterminate program transfer. Recovery: Confer with ground to determine possible erasable memory damage (ground uplink may be required).

1.6.2 Don't do V34 on the following displays: Nouns 71, 79, and 87 in IMU alignments (LNY-24). Recovery: Recall program V37EXXE.

1.6.3 If V37 is attempted within approximately 20 seconds of a fresh start, ISS turn on, ~~or restart with the IMUSE flag reset~~, a PIPA FAIL will go undetected. Recovery: Perform extended verb 42E,E,E,E.

1.6.4 If the ATT CONTROL mode sw is in AUTO or HOLD during R55 (gyro pulse torquing in P52) or during V42, the DAP will maneuver the vehicle to follow the platform as it moves

1.7 Guidance and Control, Boost, and Entry

1.7.1 Do not load a zero or negative number in R1 or R2 of N48 (DPS Pitch or Roll trim)(SDN-124). Recognition: 1204 alarm with V37 flash. Recovery: Recall present program and R03.

1.7.2 During the trimming of Lambert derived V_g, the V_g display may jump in lunar environment 0.1 fps at transfer of 30°. Recovery: For transfer of 30° trim to 150 fps.

1.7.3 The TGO display in N40 is discontinuous immediately after ignition. The ΔV measured becomes fairly constant and the computation settles out in four-to-five seconds.

1.7.4 A 1501 alarm (two users of PINBALL) during Average-G may cause indeterminate transfer of program (LNY-38).

recog — ~~FL V99~~ PROG ALARM + FLT K4+5 9 check recov — 1501

1.7.5 Responses to V99 at TIG-5 seconds may cause anomalous behavior. A memorandum is being prepared by Mr. Peter Adler of MIT/IL to explain the problems in detail. See LNY-21.

1.7.6 a) Depending upon initial gimbal angles, the VECPOINT routine may result in large desired rotations about the pointing vector when the pointing vector must be rotated through about 180° (an example of this would be in P40, P41, or P42). If the +X axis were about 180° away from the desired thrust vector, the V50N18 may display a large change in yaw desired. b) +Z axis tracking may cause large roll when MGA is near gimbal lock. Recovery: If the computed attitude is desired then simply proceed with the maneuver. If it is not, then manually maneuver in pitch and have the solution recomputed after some 20-to-30 degrees by keying ~~ENTER~~ P12 on V50N18.

1.7.7 During P40 and P42 when V99 or V97 is flashing, V06 may occasionally appear for one flash. There is no recovery procedure required.

(45° K/WT)

1.7.8 Do not select P40 or P42 if VG ≤ ~~7=(F/M)~~, where F = 200# (thrust from 2-jet ullage) and M is the mass of the vehicle (i.e., ullage DELTA V should not exceed total VG). ~~Recovery: Self recovery~~, engine on for .01 seconds; may cause engine to freeze up thereby damaging to crew safety.

1.7.9 In order to avoid excitation of the CSM-docked bending mode and possible damage to the docking tunnel, +X translation exceeding 10 seconds with jet 10 should be avoided and small steady ACA deflections with fine stick scaling (4°/sec) should be used in the ATT HOLD mode. Recognition: Perceiving a surprising increase in RCS jet activity and seeing a sinusoidal motion on the rate needles and the FDAI error needles (between 2 and 4 cps).

1.7.10 The rate command/attitude hold mode during powered flight performance with the CSM docked spacecraft configuration should be avoided. Recognition: Poor control in manual rate command mode during docked DPS burns. Recovery: Return to ATT HOLD mode by returning the rotational hand controller to center detent position or switch to the automatic mode.

1.7.11 Loss of attitude control occurs both in the ~~light ascent configuration - X translation with an undetected jet failure,~~ and in the heavy descent configuration with combined Y-Z translation. ~~Both conditions, however, can be handled by the crew.~~

1.7.12 A CALCMANU maneuver rate in excess of 0.5°/sec should not be used in the CSM-docked configuration.

1.7.13 Terminate P20 of P25 by going to P00 before selecting P40, 41, 42, 47

Recog: 1201 alarm after request for attitude maneuver LN Y 44

Recov Reload req 1742 and 1743 of REFSMMAT.

Section B

2. Ground Notes

2.1 Nouns, Verbs, and Displays

None

Section B

2.2 Selection of New Programs and Extended Verbs

2.2.1 See 1.2.1.

2.2.2 IF V85 is used during P20 ~~[illegible]~~ the downlink Shaft/Trunnion may be those read by V85 rather than those ~~taken~~ used by P20 for mark taken.

they don't intend to use this verb

Section B

2.3 Ground Updates and Pad Loads

None

Section B

2.4 Navigation and W-matrix

2.4.1 See 1.4.1.

2.4.2 See 1.4.4.

Section B

2.5 Rendezvous and Targeting

2.5.1 See 1.5.3.

Section B

2.6 Optics, IMU and Radars

None

Section B

2.7 Guidance and Control, Boost, and Entry

2.7.1 See 1.7.8.

Section B

3. Restart and Priorities

3.1 Nouns, Verbs, and Displays

3.1.1 There are five priority displays in LUMINARY which ignore any response for two seconds:

V06N49 in R22
V50N18 in P20 or P25
V05N09 in P20 (alarm codes 501, 503, 514, 525, 526, 527)
V06N05 in P20
V16N80 in P20

3.1.2 No astronaut initiated verb/noun is restart protected.

recovery : reselect verb/noun

Section B

3.2 Selection of New Programs and Extended Verbs

3.2.1 Restart will terminate extended verbs.

recovery: reselect extended verb

Section B

3.3 Ground Updates and Pad Loads

None

Section B

3.4 Navigation and W-matrix

None

Section B

3.5 Rendezvous and Targeting

None

Section B

3.6 Optics, IMU, and Radars

3.6.1 A restart during R50 coarse align will result in a coarse IMU alignment that does not reflect coarse alignment accuracy (w/r to onboard REFSMMAT). See LNY-28. Recognition: Restart light or program alarm and NOATT light during P52 with V06N22 flashing. Auto optics for fine alignment is incorrect. Recovery: 1) Finish P52 without auto optics ~~manually~~, or 2) do P51 again and then P52.

3.6.2 A hardware restart removes track enable, if P20 is in progress and will be forced back to the beginning of the designate and attitude maneuver.

recovery : self recovery

Section B

3.7 Guidance and Control, Boost, and Entry

3.7.1 Restarts will terminate attitude maneuvers.

Recovery: PRO ON V50 18 that returns to DSKY

Recog: Restart lt and/or PROG lt ON with V50 N18 Flashing

Section C

Program notes applicable to all COLOSSUS releases.

1. Crew Notes and Checklist Items

1.1 Nouns, Verbs, and Displays

1.1.1 When loading decimal data into the AGC, the ENTER sometimes changes the last digit of the loaded value since PINBALL roundoff in decimal/octal/decimal conversion occurs when data is keyed in (decimal to octal) and entered and redisplayed (octal to decimal).

Section C

1.2 Selection of New Programs and Extended Verbs

1.2.1 In ENTRY (P62-P67), V37's are inhibited after a response to "please perform separation" except a request to perform P00. To call another program, P00 must be entered first, then the desired program called. Care should be taken, however, that P62 be reselected before entering the atmosphere, since AVEG is terminated by going to P00. Of course after separation, GNCS DAP control can only be established by initialization of the entry DAP in P62.

1.2.2 When a new program selection is made via V37, the key release light will remain on during R00 and will not go off until the new program is started. ~~No further keyboard activity should be attempted until the key release light goes off and the new mode lights are displayed.~~

1.2.3 Deleted

1.2.4 Extended verbs are not restart protected. If the restart light goes on during an extended verb, the verb should be reselected.

1.2.5 In extended V67, N99 correct values to be loaded in R3 (the option code) are 1, 2, and 3. All other values except 0 are treated as 3. 0 is treated as 1.

1.2.6 In R03 (V48) the permissible values for R1 of N46 are:

vehicle config	A	0, 1, 2, 3 and 6
+X Quad AC	B	0 and 1
+X Quad BD	C	0 and 1
Deadband code	D	0 and 1
Maneuver rate	E	0, 1, 2 and 3

For R2 of N46, permissible values are:

Quad AC or BD roll code	A	0 and 1
Quad A code	B	0 and 1
Quad B code	C	0 and 1
Quad C code	D	0 and 1
Quad D code	E	0 and 1

If wrong values are loaded into R1, they will give results in r03 as follows:

A	4 is treated as 0. 5 is treated as 1. 7 is treated as 3.
B - D	All odds are treated as 1. All evens are treated as 0.
E	4, 5, 6, 7 are treated as 0, 1, 2, and 3, respectively.

Section C

All wrong odd values in R2 are treated as 1. All wrong even values are treated as 0.

Section C

1.4 Navigation and W-matrix

1.4.1 V96 could leave the other state vector and the W-matrix out of phase if requested during any permanent state vector updates, P00, P20, P22, P23, and P76, and Average-G. See also 3.1.1 Section A.

1.4.2 The W-matrix should not be initialized to magnitudes greater than 325 ft/sec and the following limits in position:

a) for rendezvous navigation - 8.5 NM
b) for orbital navigation - 8.5 NM
c) for cislunar navigation - 275 NM

Section C

1.5 Rendezvous and Targeting

1.5.1 P20 rendezvous navigation provides a priority display (V06N49) of ΔR and ΔV when the state vector update exceeds the pad-loaded erasable values RMAX and VMAX. Currently there are two problems: 1) If the display is desired before every incorporation, any negative value must be set into RMAX, not zeroes; 2) ΔR is computed as zero if $\Delta R < 256$ meters for earth or < 64 meters for moon; ΔV is computed as zero if $\Delta V < 0.006$ meters/second for earth or < 0.0015 meters/second for moon. Avoidance procedure: If it is desired to observe V06N49 for each mark then RMAX should be loaded as any negative number. Recovery procedure: None. See also anomaly report COL 21.

1.5.2 The $\underline{v_G}$ or $\underline{\Delta v}$ displays in control coordinates, N85 or N83, are based on reading the accelerometers every two seconds. The displays, however, are asynchronous one-second monitors. The result is a possible $\frac{1}{2}$ - $1\frac{1}{2}$ second delay between the application of ΔV and the visible result.

1.5.3 During rendezvous the orientation of the spacecraft about the track axis is unconstrained, when the rates are updated, approximately every eight seconds, the automatic tracking system does not demand a three-axis solution. This can result in drift around the track axis as follows: 1) for X-axis tracking at $\frac{1}{2}^{\circ}$ deadband, the maximum drift would be 0.0625°/sec (or 180° in 47 minutes). At 5° deadband, the maximum drift would be 0.5°/sec (or 180° in six minutes); 2) for preferred axis tracking the maximum drift would be 0.0761°/sec (or 180° in 39 minutes) and 0.61°/sec (or 180° in five minutes) for $\frac{1}{2}^{\circ}$ and 5° deadbands, respectively.

1.5.4 During P30 (external ΔV) the apocenter and pericenter altitude of the trajectory resulting from the addition of the uplinked ΔV to the state vector existing at ignition time is displayed. For relatively short burns this display is accurate. For the LOI1 burn, the burn time is $\approx$ 350 seconds, burning for a 170 x 60 NM ellipse. The P30 display will show a pericenter of approximately -70 NM (70 NM below the lunar surface). This characteristic is inherent to the external ΔV method of targeting for a burn. It should be pointed out that this display is predictable given the spacecraft's state and the ΔV input to P30. See also anomaly report COL 24.

1.5.5 In P17 and P77 the correct values for R3 (search option) of N72 are 1 or 2. All other values are treated as a 2.

1.5.6 In R30, P21, P38, P78, and R63 the correct values to be loaded into R2 of N06 or N12 for the option code are 1 and 2. Any other value will be treated as a 2, except P38/78 will treat a +1, 0, and -1 as a 1.

Section C

1.5.7 The assumption is made in the rendezvous targeting routines (i.e., not P30 or P31) that the resultant perigee altitude will be less than 9999.9 NM. If it is greater, then this display (N58) will become 9999.7 meaningless.

1.5.8 In P37 the correct values to be loaded into R2 for N06 are 1 and 2. Any other value will be treated as a 1.

Section C

1.6 Optics and IMU

1.6.1 In P52 and P54 the permissible values for R2 of N06 are 1, 2, 3, and 4. Illegal values,

1, 5, 11, 15 . . . . . are treated as 1.
2, 6, 12, 16 . . . . . are treated as 2.
3, 7, 13, 17 . . . . . are treated as 3.
0, 4, 10, 14 . . . . . are treated as 4.

1.6.2 ~~In P22, P23~~, P52, and P54, loads of angles greater than 90° into R1 and R2 cause erroneous results as follows:

N87

R1 (Lat): 90 + x input yields 90 - x output, but longitude is rotated 180°.

R2 (Long): 90 = x input yields -(180 - x) output.
-(90 + x) input yields +(180 - x) output.

1.6.3 In all P5X's the permissible values of R1 of N70 and/or N71 are 0 - 508 for the star code. Anything else will cause indeterminate program transfer. Recovery procedure: Confer with ground to determine possible erasable memory damage (ground uplink required).

Section C

1.7 Guidance and Control, Boost, and Entry

1.7.1 TGO display is discontinuous immediately after ignition. TGO is computed from the ratio of velocity to be gained over ΔV, where ΔV is the velocity change over the last time period. At ignition ΔV will increase until it becomes fairly constant. Until this time, the ratio will behave erratically. The computation settles down in four-to-five seconds.

1.7.2 The engine gimbal trim angles (astronaut input to N48) should not exceed 9°.

1.7.3 During P40 when V99 is flashing and during P40/R41 when V97 is flashing, V06 occasionally appears for one flash. This happens because V97 and V99 are paste verbs. There is no recovery procedure required.

1.7.4 In P61 and P62, the permissible values for R3 of N61 (headsup/headsdown) are +1 and -1. 0 is treated as -1, i.e., roll angle of 0. All positive values are treated as +1 (180° roll angle). All negative values will give a + roll angle of the value decremented by 1. These angles are scaled in revolutions (360/16384 degrees per bit).

Section C

2. Ground Notes

2.1 Nouns, Verbs, and Displays

2.1.1 The program will ignore any attempt to load Channel 7 via the DSKY. It will not even alarm. Channel 7 is the superbank indicator and is under exclusive program control.

2.1.2 See 1.1.1.

Section C

2.2 Selection of New Programs and Extended Verbs

2.2.1 See 1.2.2.

Section C

2.3 Ground Updates and Pad Loads

2.3.1 Any P27 update will destroy the preferred orientation matrix (e.g., that calculated by P40, P41), except an update of the matrix itself. Therefore, if a preferred alignment is to be part of an update, it should be the last quantity in the sequence.

2.3.2 Downrupts may be lost at infrequent intervals during high level computer activity.

2.3.3 If too large a channel number (greater than 00777) is specified with N10, PINBALL will, in the process of indexing, execute any operation code bits resulting from that channel number (i.e., bits 15 - 9). If illegal channels 35 - 77 are loaded, nothing happens. If illegal channels 100 - 777 are loaded, channels are selected on the basis of the low six bits. Recovery procedure: May need Fresh Start. See also anomaly report COL 65.

2.3.4 The lunar-solar ephemeris pad loaded data is only good for 2^{26} cs (approximately 14.5 days). If the flight lasts longer, new data must be loaded.

Section C

2.4 Navigation and W-matrix

2.4.1 See 1.4.1.

2.4.2 See 1.4.2.

Section C

3. Restart Notes

3.2 Selection of New Programs and Extended Verbs

3.2.1 See 1.2.3.

Section C

3.5 Rendezvous and Targeting

3.5.1 P37 is not restart protected. If a restart occurs, P37 has to be reselected.

Section C

3.6 Optics and IMU

3.6.1 See 1.6.1.

Section C

3.7 Guidance and Control, Boost, and Entry

3.7.1 The storing of gimbal angles at liftoff for initialization of attitude errors in P11 is not properly restart protected.

Avoidance procedure: none

Recovery procedure: Ignore attitude error needles for 2 seconds after restart.

See also anomaly report COM'6.

Section D

Program and procedure notes not applicable to the F mission.

1. Crew Notes and Checklist Items

   1.1 Nouns, Verbs, and Displays

   None

Section D

1.2 Selection of New Programs and Extended Verbs

1.2.1 Don't use V85 in P20, P22, or R29. Recovery: Recall program.

1.2.2 Do not use V93 prior to completion of P65, P66, or P67.

Section D

1.3 Ground Updates and Pad Loads

None

Section D

1.4 Navigation and W-matrix

None

Section D

1.5 Rendezvous and Targeting

None

Section D

1.6 Optics, IMU, and Radars

1.6.1 A V32 response to V16N80 in RR search in P22 can cause erroneous data when lock-on occurs. Recognition: R2 in V16N80 is not updated every two seconds during search. Recovery: Key V95E, V37E22E.

Section D

1.7 Guidance and Control, Boost, and Entry

1.7.1 If P70 has an engine fail detected, re-ignite engine manually and key proceed to V97 and proceed normally. Recovery: Go to P71.

1.7.2 Do not use V68 during 2-phase landings.

1.7.3 If P63 is terminated before Average-G starts at TIG-30 seconds, the MUNFLAG must be cleared before selecting P40, P41, P42, or P47. Recovery: After terminating P63 key V25N7E,102E,200E,E.

put in CL

Section D

2. Ground Notes

2.1 Nouns, Verbs, and Displays

None

Section D

2.2 Selection of New Programs and Extended Verbs

None

Section D

2.3 Ground Updates and Pad Loads

None

Section D

2.4 Navigation and W-matrix

None

Section D

2.5 Rendezvous and Targeting

None

Section D

2.6 Optics, IMU, and Radars

2.6.1 IMU compensation on the lunar surface is in error following P57 because the PIPA's were not set to zero after the alignment.

2.6.2 The rendezvous radar may fail to lock-on if LOS computation overflows during ascent aborts.

Section D

2.7 Guidance and Control, Boost, and Entry

None

Section D

3. Restarts and Priorities

3.1 Nouns, Verbs, and Displays

None

Section D

3.2 Selection of New Programs and Extended Verbs

None

Section D

3.3 Ground Updates and Pad Loads

None

Section D

3.4 Navigation and W-matrix

None

Section D

3.5 Rendezvous and Targeting

None

Section D

3.6 Optics, IMU, and Radars

None

Section D

3.7 Guidance and Control, Boost, and Entry

3.7.1 A restart during powered flight in P63 can cause a wrong transfer. Recovery: Fresh start.