FAO

APOLLO 12	
OPERATIONS CHECKLIST	
PART NO	S/N
SKB32100081-307	1004

STAR LIST

STAR NAME (Numerical) NO		STAR NAME (Alphabetical)	NO
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
43	Deneb	Regulus	22
44	Enif	Rigel	12
45	Fomalhaut	Sirius	15
46	Sun	Spica	26
47	Earth	Sun	46
50	Moon	Vega	36

Basic Date Changed October 6, 1969

VERB LIST (Decimal)

01 Display Oct Compnt 1 (R1)
02 Display Oct Compnt 2 (R1)
03 Display Oct Compnt 3 (R1)
04 Display Oct Compnt 1, 2 (R1, R2)
05 Display Oct Compnt 1, 2, 3 (R1,R2,R3)
06 Display Decimal (R1 or R1, R2 or R1,R2,R3)
07 Display DP Decimal - (R1,R2)
11 Monitor Oct Compnt 1 (R1)
12 Monitor Oct Compnt 2 (R1)
13 Monitor Oct Compnt 3 (R1)
14 Monitor Oct Compnt 1, 2 (R1, R2)
15 Monitor Oct Compnt 1, 2, 3 (R1,R2,R3)
16 Monitor Decimal (R1 or R1,R2 or R1,R2,R3)
17 Monitor DP Decimal - (R1,R2)
21 Load Compnt 1 (R1)
22 Load Compnt 2 (R2)
23 Load Compnt 3 (R3)
24 Load Compnt 1, 2 (R1, R2)
25 Load Compnt 1, 2, 3 (R1, R2, R3)
27 Display Fixed Memory
30 Request Executive
31 Request Waitlist
32 Recycle Prog
33 Proceed Without DSKY inputs
34 Terminate Function
35 Test Lights
36 Request Fresh Start
37 Change Prog (Major Mode)
*40 Zero ICDU (N20)
41 Coarse Align CDU (N20 & N91)
42 Fine Align IMU
43 Load FDAI ATT Error needles
*44 Set Surface Flag
*45 Reset Surface Flag
*46 Activate DAP
*47 Set LM State Vector into CSM State Vector
48 Load DAP (R03)
49 Start Crew Defined MNVR(R62)
50 Please Perform
51 Please Mark
*52 Marked on offset landing site
53 Please Mark alternate LOS
54 Start REND backup sighting mark (R23)

Basic Date ctober 6, 1969
Changed
CSM 10

55 Increment CMC Time (Decimal)
*56 Terminate Tracking (P20)
57 Start REND sighting mark (R21)
*58 Reset Stick Flag and set V50N18 flag
59 Please Calibrate
*60 Set N17 = N20
*61 Display DAP att error
*62 Display total att error (N22-N20)
*63 Display total astro att error (N17-N20)
64 Start S-band ant routine (R05)
*65 Verify Prelaunch Align Optics (CSM)
*66 Set CSM State Vector into LM State Vector
67 W-Matrix RSS Error Display
*68 CSM Stroke Test on (LM on only)
*69 Restart
70 Update Liftoff Time (P27)
71 Univ Update-BLOCK ADR (P27)
72 Univ Update-SINGLE ADR (P27)
73 Update CMC Time (Octal) (P27)
*74 Initialize erasable dump via downlink
*75 Backup Liftoff
*76 Set preferred att flag (pref track axis)
*77 Reset preferred att flag (X axis)
*78 Update prelaunch azimuth
79 Start DAP PTC/ORB RATE Routine
*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
(Select P00 by V37 after use of V96)
97 SPS Thrust Fail (R40)
99 Enable engine ignition

*Callable with other extended verb in use and does not lock out other extended verbs

NOUN LIST (Decimal)

01	Specify Machine Address (Fract) (R1,R2,R3)	.XXXXX
02	Specify Machine Address (Whole) (R1,R2,R3)	XXXXX.
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	Add +1 of error	OCTAL
	B BANK + SUPERBANK	OCTAL
	No of SELF TEST errors	OCTAL
09	Alarm Codes	OCTAL
10	Channel to be Specified (R1)	OCTAL
11	TIG (CSI)	hrs,min,.01sec
12	Option code (R1&R2)	OCTAL
13	TIG (CDH)	hrs,min,.01sec
15	Increment Machine Address (R1)	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°
30	Target Code(Gyrocomp verif)	
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	Δ 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 (1 optics,2 VHF)	0000X.
50	ΔR (miss distance)	.1 NM
	PERIGEE (HP)	.1 NM
	TFF	min-sec
51	RHO	.01°
	GAMMA	.01°
52	CENTANG (active veh)	.01°
53	RANGE	.01 NM
	RANGE RATE	.1 FPS
	PHI (lcl horiz)	.01°
54	Range	.01 NM
	Range Rate	.1 FPS
	Theta (lcl horiz)	.01°
55	Precision offset	CODE
	E(ELEV ANGLE)	.01°
	CENTANG (passive veh)	.01°

57	ΔR offset (SOR)	.1 NM
	(+ indicates behind target)	
58	HP alt (post TPI)(SOR for P38)	.1 NM
	ΔV (TPI)(SOR for P38)	.1 FPS
	ΔV (TPF)(SOR FINAL for P38)	.1 FPS
59	ΔV LOS 1	.1 FPS
	ΔV LOS 2	.1 FPS
	ΔV LOS 3	.1 FPS
60	G Max	.01 G
	V Pred	FPS
	Gamma EI	.01°
61	Impact Lat	.01°
		(+ North)
	Impact Long	.01°
		(+ East)
	Head Up/Down	+/-00001
		(+ Heads up)
62	VI-Inertial Vel Mag	FPS
	H Dot-Alt Rate	FPS
	H-Alt	.1 NM
63	RTGO from 0.05 G	.1 NM
	To Splash	
	VIO, Predicted Iner Vel	FPS
	TFE, time from .05G	min-sec
64	Drag Acceleration	.01 G
	VI, Inertial Velocity	FPS
	RTOGO to Target	.1 NM
65	Sampled CMC Time	hrs,min,.01 sec
	(fetched in interrupt)	
66	Beta, CMD Bank Angle	.01°
	CRSRNG Error	.1 NM
	DNRNG Error	.1 NM
67	RTOGO to Target	.1 NM
	Lat, Present Position	.01°
		(+ North)
	Long, Present Position	.01°
		(+ East)
68	Beta, CMD Bank Angle	.01°
	VI, Inertial Vel.	FPS
	H Dot, Alt Rate	FPS
69	Beta	.01°
	DL	.01 G
	VL	FPS

Basic Date October 6, 1969
Changed
CSM

70	Star Code(before mark)		OCTAL
	LMK Data		OCTAL
	Horiz data		OCTAL
71	Star code (after mark)		OCTAL
	LMK Data		OCTAL
	Horiz data		OCTAL
72	Δ ang		.01°
	Δ alt		.1 NM
	Search option		
73	ALT (P21)		10 NM
	VEL (P21)		FPS
	GAMMA (P21)		.01°
74	BETA, CMD Bank Angle		.01°
	VI, Inertial Velocity		FPS
	Drag Acceleration		.01 G
75	ΔH (CDH)		.1 NM
	ΔT		min-sec
	ΔT		min-sec
79	PTC/Orb Rate		.0001°/sec
	PTC/Orb deadband		.01°
	PTC/Orb Code		XXXXX
80	TF GETI/TFC		min-sec
	VG		FPS
	ΔV (Accumulated)		FPS
81	ΔVX,Y,Z (lcl vert)		.1 FPS
82	ΔVX,Y,Z (LV) CDH		.1 FPS
83	ΔVX,Y,Z (Body Control Axis)		.1 FPS
84	ΔVX,Y,Z (Other Vehicle)		.1 FPS
85	VGX,Y,Z (Body Control Axis)		.1 FPS
87	Opt Calib Data - Shaft (R1)		.01°
	Trunnion(R2)		.001°
88	Planet	X	.XXXXX
		Y	.XXXXX
		Z	.XXXXX
89	Landmark - Lat		.001° (+ North)
	Long/2		.001° (+ East)
	Alt		.01 NM
90	REND out of	Y	.01 NM
	Plane para	Y DOT	.1 FPS
		PSI	.01°
91	OCDU Angles Shaft (R1)		.01°
	Trunnion (R2)		.001°

92	New OCDU Angles Shaft (R1)	.01°
	Trunnion (R2)	.001°
93	Delta Gyro Angles X,Y,Z	.001°
94	OCDU ANGLES (R56 & R23)	
	R1 SHAFT	.01°
	R2 TRUNNION	.001°
95	Pref att ICDU angles	.01°
96	+X axis att ICDU angles	.01°
97	System Test Inputs	XXXXX.
		XXXXX.
		XXXXX.
98	System Test Results	XXXXX.
		.XXXXX
		XXXXX.
99	POS ERR	1 FT
	VEL ERR	.1 FPS
	OPTION Code	0000X

V05 N09 ALARM CODES

00110 Mark reject has been entered but ignored
Continue

00112 Mark reject with no marks being accepted
Continue

00113 No inbits (chan 16)
Continue; if alarm recurs use MDC DSKY.

00114 More marks made than desired
Continue

00115 V41 N91 keyed with OPTICS MODE not in CMC
OPTICS MODE - CMC and OPTICS ZERO - OFF

00116 Optics switch altered before 15 sec zero time elapsed
OPTICS ZERO - ZERO (15 sec).

00117 V41 N91 keyed but CMC has reserved OCDU (from start of gimbal test in P40 until termination of TVC functional allocation of the "optics" CDU Driving Output)
V41 N91 not yet available

October 6, 1969
Basic Date
Changed
CSM 10

00120 Optics torque has been requested but optics have not been zeroed since last FRESH START or RESTART
OPTICS ZERO - OFF then ZERO (15 sec).

00121 In 0.05 sec following mark, an ICDU changed by more than 0.033°
Repeat MK.

00122 Marking not called for
Continue.

00124 P17 (77) TPI search unsuccessful
(F/3-1)

(m)00205 PIPA saturated
Use SCS control (G&N 12).

00206 The IMU zero routine has been entered with both the GMBL LOCK lt and NO ATT lt on
Coarse align to 0,0,0 Reselect V40 N20E.

(m)00207 ISS turn-on request not present for 90 sec
Redo IMU turn on (G&N 12).

(m)00210 The IMU is not operating
Redo IMU turn on. If alarm recurs perform fresh start (V36E).
Consult MSFN. (G&N 12).

(m)00211 Coarse align error
If P51(3)/52(4) in progress record gyro torquing angles and perform fine align check in P52(4).
Otherwise, see F/8-2. (G&N 12).

(m)00212 PIPA fail, but PIPA is not being used
PIPA BIAS check (G&N 6/8).

(m)00213 IMU not operating with turn-on request
See 00210

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

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

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

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

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

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

00406 Rend navigation not operating
Select P20 or continue.

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

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

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

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

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

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

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

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

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

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

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

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

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

October 6, 1969
Basic Date Changed
CSM

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

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

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

(m)01107 Phase table failure-assume erasable memory is destroyed
If Comm: 1. V74 CMC DOWNLINK
2. P27 As Necessary.
3. V48 As Necessary (V46).
4. Reestablish REFSMMAT via P51 As Necessary.
If FRESH START recurs, CMC FAILURE (SSR-3).
If no Comm, pg AC/1-9

01301 Arcsin or arccos input is greater than one
Copy N08, notify MSFN, continue.

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

01426 IMU unsatisfactory
Realign or use SCS.

01427 IMU reversed
Note FDAI operation is inverted.

01520 V37 request not permitted at this time
Wait till COMP ACTY lt. not on continuously - reselect V37 or if P62-67, select P00 and then desired program.

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

01601 Bad IMU torque abort
See 01600

01602 Bad optics during verification
See 01600

01703 Insufficient time for integration. TIG slipped
(F/5-4,5-9,E/4-4)

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

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

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

(m)10777 ISS warning caused by IMU & PIPA
fail (G&N6)

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

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

**20430 Orbital integration has been
terminated to avoid possible
infinite loop.
Notify MSFN.
Probable S.V. uplink required

**20607 No solution to conic subroutine
Reselect program.

**20610 Alt at specified TIG in P37 < 400K ft
Reselect P37 and decrease TIG.

**21103 Unused CCS branch executed
Copy N08, notify MSFN, initiate V36
recovery

**21204 Negative or zero time waitlist call.
If ave-g on, continue.
Otherwise reselect program.

**21206 Second job attempts to go to sleep via
keyboard and display program
See 21204.

**21210 Second attempt is made to stall
Reselect program
Do not attempt use of device while CMC is
using it.

**21302 SQRT called with negative argument
See 21204

**21501 Keyboard and display alarm during
internal use
See 21204

**21502 Illegal flashing display
See 21204

October 6, 1969
Basic Date
Changed
CSM

**21521 V92 keyed (P07) during P00 or P01 selected and P11 has already been performed
See 21204

*31104 Delay routine busy
Reselect extended verb or continue with program.
Notify MSFN.

*31201 Executive overflow - no vac, area
Reselect Extended Verb and/or Continue Program.

*31202 Executive overflow - no core sets
See 31201

*31203 Waitlist overflow - too many tasks
See 31201

*31207 No vac area for marks
Rset
Reselect program
If alarm recurs, consult MSFN.

*31211 Illegal interrupt of extended verb
Reselect extended verb after optics marking is completed.

(m) - Malf procedure indicated
**(2xxxx) - Generates restart, F37 (no lt)
*(3xxxx) - Restart (no lt) and program continues (i.e. attempted recovery)

NOTE - All **alarms act as *type if they occur when Ave-g is on

October 6, 1969
Basic Date Changed
CSM 108

V50 N25 CHECKLIST CODES

R1 Code	ACTION	FUNCTION
00013	Key in	Gyro Torque Option (P52,54)
00014	Key in	Fine Align Option
00015	Perform	Celestial Body Acq
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 opt

V04 N06 (N12)OPTION CODES

R1 Code	Purpose	Input for R2
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

Basic Date October 6, 1969
Changed

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(RNDV)	00101	1	W-matrix for rendezvous navigation is valid	W-matrix for rendezvous navigation is invalid
W-Matrix (ORB)	00077	6	P22,P23 W-matrix valid	P22,P23, W-matrix invalid
3 axis	00101	6	MNVR Specified by 3 axes	Maneuver specified 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 rendezvous program computations
Sighting mark	00074	6	V51 initiated	V51 not initiated

FLAG WORD LISTING

TITLE	ADDRESS	BIT	WHEN SET	WHEN RESET
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
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

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

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

1 Set
0 Reset

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

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 00E

IMU POWER UP PROCEDURE

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

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

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

OPTICS POWER UP PROCEDURE

1 G/N PWR OPTICS - on (up)

2 OPT ZERO - OFF
OPT ZERO - ZERO (15 sec)

October 6, 1969
Basic Date Changed
CSM 108

P06 - CMC POWER DOWN PROGRAM

1		V48E
	F 04 46	Load 0 (NO DAP) in left digit of R1
		PRO
		PRO
		PRO
		V46E
2		V37E 06E
	F 50 25	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 *

OPTICS POWER DOWN

1 G/N PWR OPTICS - OFF

CMC SELF CHECK

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

G&N GEN
Basic Date October 6, 1969
Changed
CSM 1

4 15 01 TEST SUCCESSFUL WHEN R2≥3 (78 sec)
* IF PROG 1t - On *
* V05 N09E 01102 SELF *
* TEST ERROR *
*N8E-Rec for MSFN *
(TERM) V21N27E 0E

MEASUREMENT & LOADING OF PIPA BIAS

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

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

3 V06 N21 (do not ENTR)
06 21 XYZ PIPA COUNTS

4 At T + 1:04 - ENTR
T1:04
Record (X) R1____ (Y) R2____ (Z) R3____ (±XXXAB)

5 V21N 01E (use same sign as above)
F 21 01 1452 E (CALCULATED X BIAS) E,E,(±ABXXX)
1454 E (CALCULATED Y BIAS) E,E
1456 E (CALCULATED Z BIAS) E

FLAG WORD SET/RESET

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

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

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

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

Key:

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

EXAMPLE: To set REFSMMAT flag:

Key:

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

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

October 6, 1969
Basic Date Changed
CSM

REVIEW DATA IN ERASABLE MEMORY

1		Perform During Any Flashing Display
2		V01 N01E (OCTAL ADD) E
3	F 01 01	R1 DATA R3 OCTAL ADD
4		N15E (For next succeeding word)
5		ENTR (For each succeeding word)

TO CHANGE DATA IN ERASABLE MEMORY

1		V21 N01E (ADDRESS) E
	F 21 01	R3 ADDRESS
		Load New Data in R1 E
		N15E (For next succeeding word)
		ENTR (For each succeeding word)

P22 RAW DATA READOUT

CMC - on, HOLDING AT 06 49 FLASH IN P22

1	F 06 49	V1N1E
2	F 01 01	3537E
		Rcrd R1
		N15E
		Rcrd R1
3	F 01 15	ENTR
		Rcrd R1
4		Repeat 3 till 7 pieces of data recorded for each mark
5		KEY RLSE
6	F 06 49	Continue P22

October 6, 1969
Basic Date Changed
CSM 108

MONITOR OF INPUT/OUTPUT CHANNELS

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

LOAD OUTPUT CHANNELS

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

PITCH ORBIT RATE MANEUVER

(Save RCS - Disable 2 Adjacent Quads in R03)

1		V37E 00E
		V49E
		Load N22 With Desired Initial Attitude MGA=0, OGA = 7.25
2	F 06 22	
		PRO
3	F 50 18	BMAG MODE (3) - RATE 2
		SC CONT - CMC
		CMC MODE - AUTO
		PRO
4	06 18	AUTO MANEUVER
	F 50 18	
5		ENTR
6		V79E
7	F 06 79	RATE, DB, CODE (.0001°/sec,.01°,+XXXXX)
		Load desired values in R1&R2 & non-zero in R3
		PRO

Basic Date October 6, 1969
Changed
CSM 1

8 To Terminate
1. SC CONT - SCS
or 2. CMC MODE - HOLD
or 3. V46E
or 4. V37E XXE
RHC out of detent will stop mnvr, but will not collapse DBD

RCS DAP ATT DBD INCREASE

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

1 V21 N01E
3255E
DBD (see table)

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

2 To return to R03 DBD
THC - CW, then neutral
(DBD center shifted)
or V48E (DBD center not affected)
PRO
PRO
PRO
or V37E XXE

VHF RNG DSKY DISPLAY

VHF RNG - on (up)
P20 - running

1 V87E
V06 N02E
3703E
R1=XXX.XX nm
(max R1 = 163.83;
if R1 neg, RNG = 327.67 - R1)

Basic Date October 6, 1969
Changed
CSM 108

G&N RECOVERY PROCEDURES

General System Checkout:

Get to P00 by one of the following:

1. V37E 00E
2. V96E
3. V36E V96E
4. Simultaneously press RSET and MARK REJECT, (GO JAM), V37E 00E

Check for Reasonableness

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

Recoveries:

if P06: (with F 50 25 00062)

1. a. Press PRO to STBY, press PRO again to F 37

   or

   b. V37E 00E
2. V25 N7E, 76E, 40000E, 1E
3. V25 N7E, 77E, 10000E, 1E

if V30 or 31:

RECORD N26, NOTIFY MSFN, V74E
Perform General System Checkout

if V36:

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

if GO JAM:

V74 when convenient, see V36

Basic Date October 6, 1969
Changed
CSM

RAPID IMU REALIGN

NOTE: This procedure assumes a good GDC alignment

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

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

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

4 V25 N7E, 76E,
40000E, 1E (Sets Drift Flag)

5 V25 N07E
77E, 10000E, 1E (Sets REFSMMAT FLAG)

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

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

CHANGING LANDING SITE REFSMMAT FOR OUT-OF-PLANE BURNS

1 V37E 52E

2 F 04 06 R1=00001
R2=00004 (LOAD LANDING SITE OPTION)

3 F 06 34 GET ALIGN (LOAD TIME OVER LANDING SITE)

4 F 06 89 LAT, LONG/2,ALT (LOAD R1: +35000 FOR +ΔVy
or -35000 FOR -ΔVy)

5 F 06 22 NEW ICDU ANGLES

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

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

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

2    F 06 72     ΔANG(TPI),ΔALT(TPI),SEARCH OPT
                                 (.01°,.1nm,0000X)
                 R3=SEARCH OPT   00001<180°
                                 00002>180°
          (change GETI TPI)      V32E to 1
          (change Search opt)    V23E
                 PRO
                      *F 05 09 00124 alarm code *
                      *V32E, RSET to 1 to adjust*
                      *GETI or SEARCH OPTION    *

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

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

5    F 37        XXE
```

P20 - RENDEZVOUS NAVIGATION

```
                CMC - on (req)
                ISS - on and aligned (req)
                SCS - on (des)
                BMAG MODE (3) - RATE 2
                G/N OPT PWR - on (verify)
                OPT ZERO - ZERO (verify)
                OPT MODE - CMC

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 UPLINK ACTY lt            *
                    *(Mnvr >10° req'd)              *
                    *To restablish F 50 18          *
                    *  Key V58E                     *

                    *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,0000X)  *
                      *(REJECT)  V32E                *
                      *(ACCEPT)  PRO                 *

                      OPT ZERO - ZERO

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

3                V54E (COAS)
     F 06 94     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,0000X)  *
                      *(REJECT)  V32E                *
                      *(ACCEPT)  PRO                 *

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

P21 GROUND TRACK DETERMINATION

CMC - on (req)

1		V37E 21E
	F 04 06	R1 00002, Specify Vehicle
		R2 00001, CSM
		or 00002, LM
		PRO
2	F 06 34	GET LAT,LONG (hrs,min,.01sec)
		Load desired GET (for present time, use all zeroes)
		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

NOTE: Additional Information is available
by V6 N73E
N73 Alt,VEL,GAMMA(10nm,fps,.01°)

P22 - ORBITAL NAVIGATION

CMC - on (req)
ISS - on and aligned (req)
SCS - on (req)
BMAG MODE (3) - RATE 2
G&N PWR OPTICS - on (verify)
COUPLING - RESOLVED
SPEED - MED
OPT ZERO - ZERO (verify)
OPT MODE - CMC

```
1                V37E 22E
     F 06 45     R3=MAX MGA                          (.01°)
          (REJECT)  R3>60° to P52
                    R3<60° IMU ALIGNED
                MNVR To SIGHTING ATTITUDE
                        Roll to keep shaft axis >10° from
                        plane defined by X axis & LOS
                        to LMK
          (MAN)     OPT MODE - MAN
                    OPT ZERO - OFF
                PRO (To 3 for earth orbit)
          (AUTO)    OPT ZERO - OFF
          PRO (To 3 for earth orbit)

2    F 05 70      (lunar orbit only)
                  R2 ABCDE lmk code
                  Load lmk code
                                SITE = 10001
                                KNOWN = 10000
                                UNKN  = 20000
                    A=1(known), 2(unknown)
                    B=INDEX OF OFFSET designator
                    C=not used
                   DE=LMK ID (0,1, 5X are legal)
                  IF A=2
                      OPT MODE - MAN
                  PRO to 5                          (+ = NORTH)
            or    IF A=1 & DE≠00
                  PRO to 4 (To 5 if OPTICS - MAN)
            or    IF A=1 & DE=00
                  PRO to 3
```

```
3    F 06 89   LAT,LONG/2,ALT        (.001°,.001°,.01nm)
               Load lmk coords
               PRO (To 5 if OPTICS - MAN)

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

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

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

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

8    F 06 49   ΔR,ΔV (ORB PARA)            (.1nm,.1fps)
          (RECYCLE) V32E to 2
          (ACCEPT) Hold for 30 sec
               PRO
```

Basic Date October 6, 1969
Changed
CSM 1

9 F 06 89 LAT,LONG/2,ALT LMK ID
(.001°,.001°,.01nm)
(DON'T STORE) V32E to 2
(STORE-CODE 01) PRO to 2
(terminate Prog) V34E

10 F 37 XXE
OPT ZERO - ZERO

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

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

2 F 50 25 00202 MNVR/CALIB REQUEST
ENTR

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

4 F 06 87 R2 TRUNNION ANGLE BIAS (.001°)
(repeat until 2 measurements
agree within .003°)
For manual load:
V22 N94E
XXXXXE
(ACCEPT) PRO
(REJECT) V32E to 3

5 F 51 V37E XXE
OPT ZERO - ZERO

P23 - CISLUNAR MIDCOURSE NAV MEASUREMENT

NOTE: Do not allow P23 to run more than 30 min

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

1 V37E 23E

2 F 05 70 R1 000DE STAR ID
R2 00C00 LMK ID
R3 00CD0 HOR ID

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	00200
00120	00220	00000

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

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

4 F 06 88 CELESTIAL BODY VECTOR
LOAD DESIRED VECTOR
PRO

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

```
6     F 50 18   REQUEST MNVR TO FDAI R,P,Y          (.01°)
                (AUTO)      SC CONT - CMC
                            CMC MODE - AUTO
                            BMAG MODE (3) -RATE 2
                            PRO to 7
                (MAN)       V62E
                            MNVR to 6
                (BYPASS)    ENTR to 8 (CALIB COMPLETED to 10)

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

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

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

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

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

                (MARK)      MNVR SC TO POSITION LMK/HOR
                              IN FOV
                            OPT MODE - MAN
```

11	F 51	MARK REQUEST (MNVR) V94E to 6 (MARK) SUPERIMPOSE STAR ON LMK/HOR MARK
12	F 50 25	00016 TERM MARKS (REJECT) MARK REJECT to 11 (TERM) PRO
13	F 05 71	R1 00DE STAR ID R2 00C00 LMK ID R3 00CD0 HOR ID (STAR/HOR) PRO to 16 (DE=00 to 15) (STAR/LMK)PRO to 14
14	F 06 89	LAT, LONG/2 ALT(LMK) (.001°+N/E,.01nm) PRO (DE≠00 to 16)
15	F 06 88	CELESTIAL BODY VECTOR Verify vector PRO
16	F 06 49	ΔR ΔV (SV PARA) (.1nm,.1 fps) (REJECT) V37E 23E (UPDATE) PRO
17	F 37	

P27 CMC UPDATE

CMC - on (req)

Auto Update:

1 V37E 00E

UP TLM (2) - 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 (2) - BLOCK          *
```

Update complete:

UPLINK ACTY lt - out

V37E 00E

UP TLM (2) - BLOCK

Voice Transmission Update:

1 V37E 00E

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

3 P27 Displayed

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

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

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

7 P00 Displayed

P30 EXTERNAL ΔV

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

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

P31 GENERAL LAMBERT PRETHRUST

TARG PARAMS - LOADED FROM GND (P27)

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

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

5    F 37
```

P32 CSI PRETHRUST

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

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

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

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

```
*F 05 09                        *
* 00600 No Intersection on      *
*       First Iteration         *
* 00601 hp+CSI <85nm/5.8nm      *
* 00602 hp+CDH <85nm/5.8nm      *
* 00603 TIG(CDH)-TIG(CSI)       *
*         <10 min               *
* 00604 TIG(TPI)-TIG(CDH)       *
*         <10 min               *
* 00605 NO SOL IN 15 Tries      *
* 00606 ΔV(CSI)>1000fps in 2    *
*       Iterations              *
*       V32E to 1 Adjust        *
*         Inputs                *
```

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

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

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

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

9 F 37

P33 CDH PRETHRUST

1 V37E 33E
F 06 13 TIG(CDH) (hrs,min,.01sec)
PRO

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

```
*F 05 09 00611 NO TIG FOR*
*          SPECIFIED ANGLE *
*  (REDO)V32E to 1         *
*          PRO to 3        *
*CMC will use last         *
*  calculated value of     *
*  TIG (TPI)               *
```

3 F 06 75 ΔH(CDH),ΔT(TPI-CDH),ΔT(TPI-NOMTPI)
PRO (.1nm,min-sec)

4 F 06 81 ΔV XYZ(LV)CDH (.1fps)
(For Out-of-Plane Corr in Final Comp ONLY)
V90E
F 04 12 R1 00002 Specify Vehicle
R2 00001 CSM
00002 LM
PRO
F 06 16 GET EVENT (hrs,min,.01sec)
PRO
F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
Record Y DOT
PRO
Insert -Y DOT in R2 of ΔV (CDH)
PRO (If Recycling to 2)

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

6 F 37

P34 TPI PRETHRUST (P74 LM)

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

Basic Date October 6, 1969
Changed
CSM

```
2    F 06 55   PRECISION OFFSETS, ELEV ANGLE, ωt
                                        (0000X,.01°,.01°)
               Load desired values
               (+00000 in R2 to CALC ELEV
                ANGLE AT TIG TIME)
               PRO

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

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

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

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

6    F 06 81   ΔVXYZ(LV)TPI                      (.1fps)
               (For Out-Of-Plane Corr in final Comp only)
               Key V90E
                 F 04 12 R1 00002 Specify Vehicle
                         R2 00001 CSM
                            00002 LM
                         PRO
                 F 06 16 GET EVENT     (hrs,min,.01sec)
                   PRO
                 F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
                   RECORD YDOT _______
                   PRO
                 INSERT - (YDOT) in R2 of ΔV TPI
               PRO

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

Basic Date October 6, 1969
Changed _____
CSM 108

```
8    F 16 45   MARKS,TFI,MGA        (marks,min-sec,.01°)
               PRO (MGA SET To -00002 IF NO
                    REFSMMAT SET or If P74)

9    F 37
               P74 - Transmit Mnvr Parameters To LM
```

P35 TPM PRETHRUST P75 LM

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

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

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

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

5    F 37
               P75 - Transmit Mnvr Parameters To LM
```

Basic Date ctober 6, 1969
Changed
CSM

P37 RETURN TO EARTH PGM - CORRIDOR CONTROL

Perform the following once:
V1N1E
3376E
Verify R1=01623

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

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

```
*F 05 09 00605-Solution Not    *
*              Convergent      *
*        00612-State Vector in*
*              Lunar Influence*
*V32E,RSET To 1                *
*        20607-Conic Routine   *
*              Failed          *
*        20610-State Vector    *
*              Below 400K ft   *
*              alt             *
*F 37 37E to 1                 *
```

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

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

Basic Date October 6, 1969
Changed October 27, 1969
CSM 108

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

6    F 06 81   ΔVXYZ(LV) TIG                  (.1fps)
     (OPTION) N40E - VG MAG avail
                 in N40 and N80
              KEY REL
               PRO (To 3 on first pass)

                      *F 05 09 00605 Solution Not    *
                      *              Convergent      *
                      *        00613 Flt Path Angle *
                      *              Not Reached     *
                      *  RSET                        *
                      *  V32E To 1                   *
                      *        20607 Conic Routine   *
                      *              Failed          *
                      *F 37 37E to 1                 *

7    F 04 06   THRUST OPTION
               R1 00007
               R2 0000X
                    X=1(SPS)
                      2(RCS)
               Perform R03 if not performed just
                 prior to P37 call
               PRO

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

9    F 16 45   MARK,TFI,MGA       (mark,min-sec,.01°)
               PRO (MGA SET TO -00002 If No
                    REFSMMAT SET)
                         *Do not key V32E*

10   F 37      (40E or 41E)
```

Basic Date October 6, 1969
Changed October 27, 1969

CSM

P37 RETURN TO EARTH PGM - LONGITUDE CONTROL

(CANNOT USE WHEN TIME TO ENTRY IS <4 HRS)

Perform the following once:
    V1N1E
    3376E
    Verify R1=01623

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

2    F 06 60     BLANK,ΔV DESIRED, GAMMA EI DESIRED
                 Load desired ΔV:                    (fps,.01°)
                      PAD ΔV IF ON TLC
                      0.     IF ON TEC
                 Load R3=0
                 R2   XXXXX
                 PRO
                      *F 05 09  00612 State vector in  *
                      *               Lunar Influence  *
                      *         00605 Solution not     *
                      *               Convergent       *
                      *V32E, RSET TO 1                 *
                      *         20607 Conic Routine    *
                      *               Failed           *
                      *         20610 State vector is  *
                      *               below 400K ft    *
                      *               altitude         *
                      *F 37 37E to 1                   *

3    F 06 61     IMPACT LAT, IMPACT LONG             (.01°)
     If Impact LONG<12° from desired:
       Record Impact LONG as Θcl _____
       PRO
```

Basic Date October 6, 1969
Changed October 27, 1969

CSM 108

If Impact LONG>12° from desired:

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

TLC: V32E to 1
Decrease ΔV to move LONG WEST
Increase ΔV to move LONG EAST

4 F 06 39 ΔT TRANSFER (hrs,min,.01sec)
PRO

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

6 F 06 81 ΔVXYZ(LV) at TIG
N40E
Record R2 as ΔVcl=_____fps
KEY RLSE
PRO

```
*F 05 09   00605 Solution not  *
*                Convergent   *
*          00613 Flt Path Ang *
*                not reached  *
*RSET V32E to 1               *
*          20607 Conic Routine *
*                Failed       *
*F 37 37E to 1                *
```

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

PRO

8 F 06 39 ΔT TRANSFER
PRO

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

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

Basic Date October 6, 1969
Changed

CSM

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

12 F 06 60 BLANK,ΔV DESIRED, GAMMA EI DESIRED
To move West from θp1
TEC: Load ΔVc2 =-ΔVc1-10
TLC: Load ΔVc2 =ΔVc1-10
To move EAST from θp1
TLC or TEC: Load ΔVc2=ΔVc1+10
Record ΔVc2_____fps
R2 XXXXX.
PRO
F 05 09 SAME AS IN 2
*V32E. RSET to 11 *

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

Compute K= $\frac{\theta c2-\theta c1}{10}$ +_____

Compute ΔθLong =θd-θp1= ± _____

Obtain from Chart ΔVo = ± _____

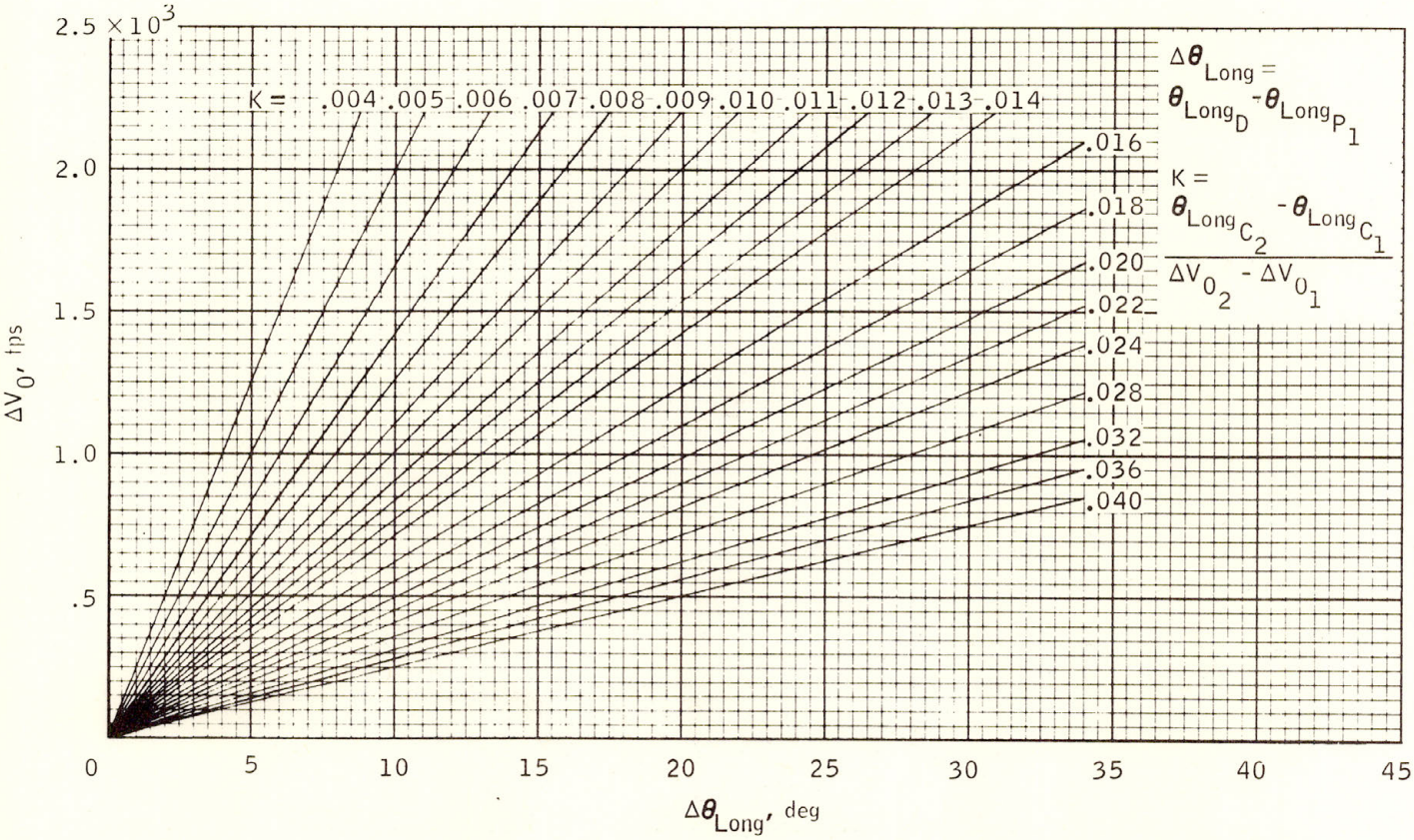
Make sign of ΔVo same as Δθ Long
If ΔVc2 pos, ΔVd= ΔVp1(step 10)+ ΔVo
If ΔVc2 neg, ΔVd= -ΔVp1+ ΔVo
ΔVd=_____

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

OBTAIN ENTRY REFSMMAT (No Comm)

1. Record 400K time from final P37 solution. (Step 1 TIG + FNL N39)
2. Use 400K time for T-align P52 (Option 2).
   NOTE: P37 MCC used to compute T-align must be performed prior to step 2.

Basic Date October 6, 1969
Changed October 29, 1969



F
4-13

ΔV0 Vs Δθ Long

P37 BLOCK DATA

									GETI
X					X				ΔVT
X	☐				X	☐			LONG
									GET_{400K}
									GETI
X					X				ΔVT
X	☐				X	☐			LONG
									GET_{400K}
									GETI
X					X				ΔVT
X	☐				X	☐			LONG
									GET_{400K}
									GETI
X					X				ΔVT
X	☐				X	☐			LONG
									GET_{400K}
									GETI
X					X				ΔVT
X	☐				X	☐			LONG
									GET_{400K}
									GETI
X					X				ΔVT
X	☐				X	☐			LONG
									GET_{400K}
									GETI
X					X				ΔVT
X	☐				X	☐			LONG
									GET_{400K}

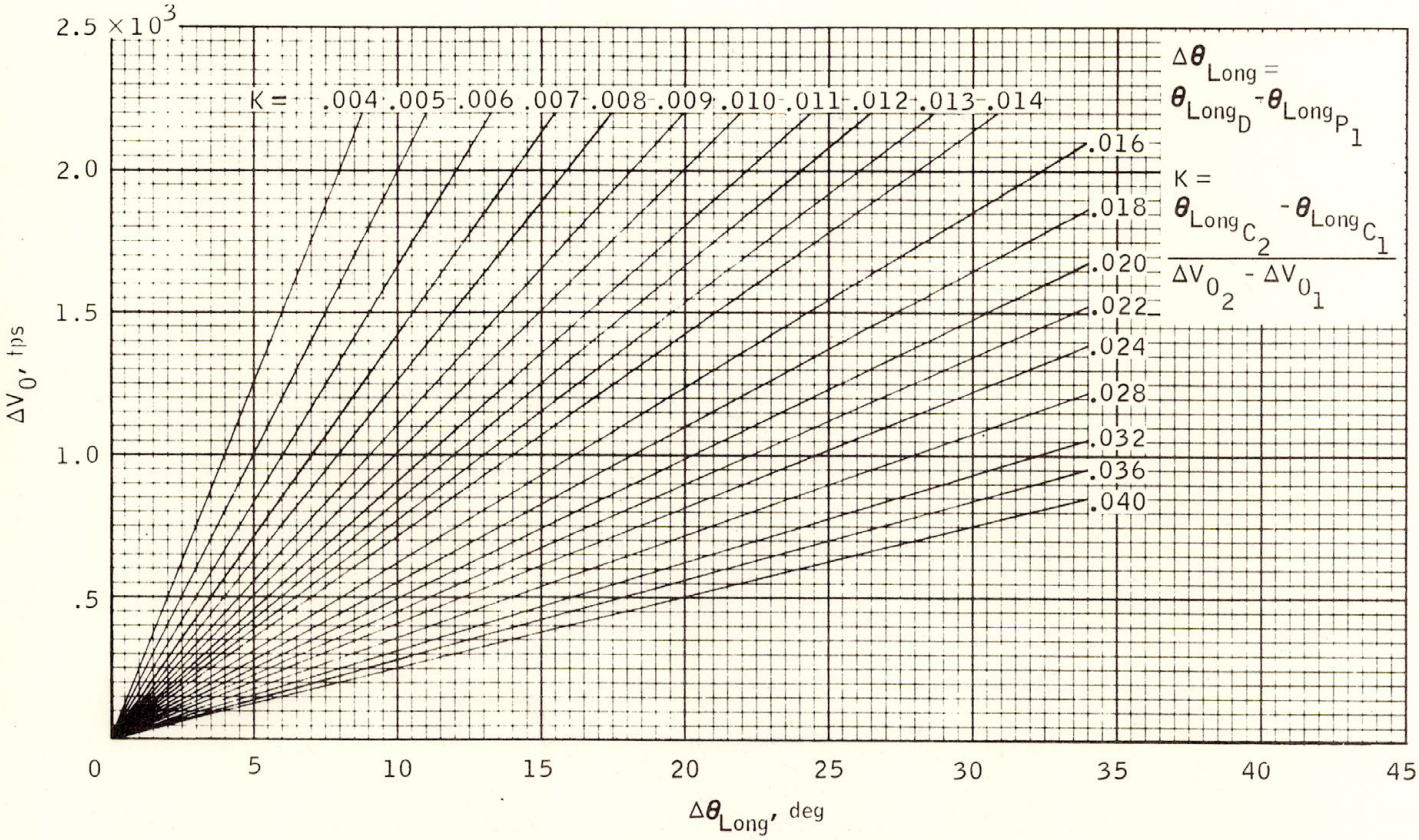
Basic Date October 6, 1969
Changed

CSM

P37 BLOCK DATA

ΔV_0 Vs $\Delta\Theta$ Long

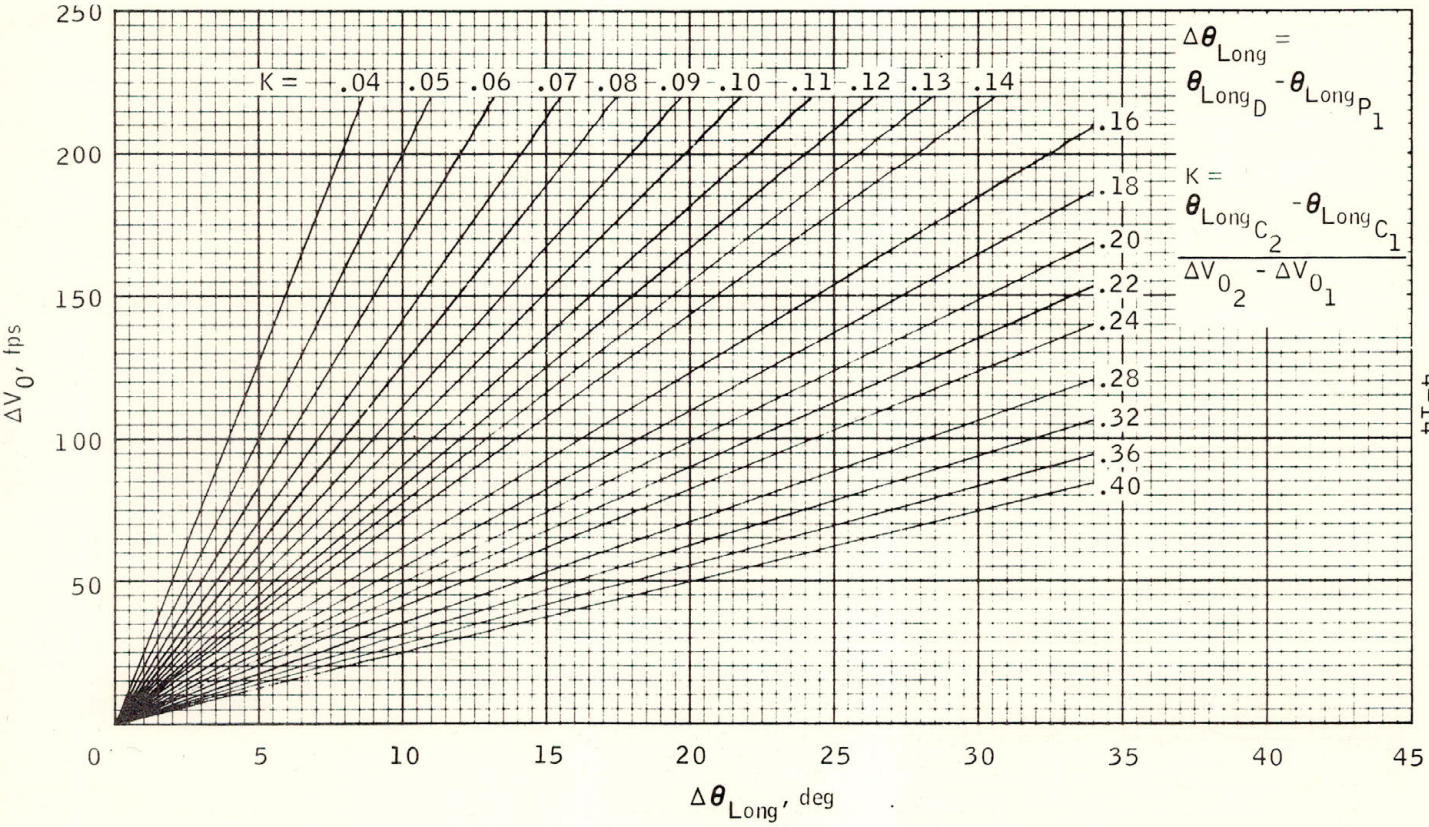
Basic Date October 6, 1969
Changed October 29, 1969



F
4-13

ΔV0 vs Δθ Long

ΔV_0 Vs $\Delta\Theta$ Long



F 4-14

Basic Date October 6, 1969
Changed October 29, 1969

NASA — MSC

								GETI
X				X				ΔVT
X				X				LONG
								GET_{400K}
								GETI
X				X				ΔVT
X				X				LONG
								GET_{400K}
								GETI
X				X				ΔVT
X				X				LONG
								GET_{400K}
								GETI
X				X				ΔVT
X				X				LONG
								GET_{400K}
								GETI
X				X				ΔVT
X				X				LONG
								GET_{400K}
								GETI
X				X				ΔVT
X				X				LONG
								GET_{400K}
								GETI
X				X				ΔVT
X				X				LONG
								GET_{400K}

P37 BLOCK DATA

F
4-16

									GETI
X					X				ΔVT
X					X				LONG
									GET 400K
									GETI
X					X				ΔVT
X					X				LONG
									GET 400K
									GETI
X					X				ΔVT
X					X				LONG
									GET 400K
									GETI
X					X				ΔVT
X					X				LONG
									GET 400K
									GETI
X					X				ΔVT
X					X				LONG
									GET 400K
									GETI
X					X				ΔVT
X					X				LONG
									GET 400K
									GETI
X					X				ΔVT
X					X				LONG
									GET 400K

Basic Date October 6, 1969
Changed

CSM

P38 SOR TARGETING (P78 LM)

1		V37E (38E or 78E)	
	F 06 33	TIG (SOR)	(hrs,min,.01sec)
		Load desired TIG	
		PRO	
2	F 06 55	R3 ωt	(.01°)
		Load desired ωt	
		PRO	
3	F 04 06	R1 00005 Specify Phase Option	
		R2 0000X X=1 or 2	
		PRO (To 6 If R2=2)	
4	F 06 57	ΔR SOR	(.1nm)
		Load desired ΔR	
		PRO	
5	F 06 34	SOR TIME	(hrs,min,.01sec)
		PRO	
6	F 16 45	MARK,TFI,-00001	(mark,min-sec,.01°)
		(RECYCLE) V32E	
		(FINAL PASS) PRO (Terminate Marks)	
7	F 06 58	HP(SOR),ΔV(SOR),ΔV(SOR-FINAL)	
		PRO	(.1nm,.1fps,.1fps)
8	F 06 81	ΔVXYZ(LV)	(.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 ΔVXYZ(LV) (.1fps)
PRO (If Recycle - To 2)

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

5 F 37

P79 - Transmit Mnvr Parameters To LM

THRUSTING

P40-SPS THRUSTING

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

MNVR TO PAD BURN ATT

1 V62E

2 V49E

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

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

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

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

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

8 V41 N91E

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

10 41 OPTICS DRIVE

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

11 V37E 40E

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

13 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)

14 F 50 18 REQUEST TRIM MNVR TO FDAI RPY ANGLES
ALIGN S/C ROLL (.01°)
GDC ALIGN

TVC CHECK & PREP
cb STAB CONT SYS (Pnl 8) - close
cb SPS (12) - close
SET ΔVC (verify)
EMS FUNCT - ΔV (verify)
MAN ATT (3) - RATE CMD
LIMIT CYCLE - ON
ATT DB - MIN
RATE - LOW
TRANS CONT PWR - ON
SCS TVC (2) - RATE CMD
ΔVCG - LM/CSM or CSM
TVC GMBL DRIVE P&Y - AUTO

+54:00m MN BUS TIE (2) - ON
(-06:00) TVC SERVO PWR #1 - AC1/MNA
TVC SERVO PWR #2 - AC2/MNB
ROT CONTR PWR NORMAL (2) - AC
ROT CONT PWR DIRECT (2) - OFF
BMAG MODE (3) - ATT1/RATE 2
SC CONT - SCS
RHC #2 - ARMED

55:00m PRIMARY TVC CHECK
(-05:00) GMBL MOT P1-Y1 - START/ON (LMP Confir
Verify TRIM CONTROL & SET
Verify MTVC
IF SCS: SCS TVC (2) - AUTO
SC CONT - CMC (SCS)
THC - CW
Verify NO MTVC

SEC TVC CHECK
GMBL MOT P2-Y2 - START/ON (LMP Confir
SET GPI TRIM
Verify MTVC
THC NEUTRAL
Verify NO MTVC

Basic Date October 6, 1969
Changed
CSM 108

```
                    Verify GPI returns to 0,0(CMC) or trim
                      (SCS)
                    ROT CONT PWR NORM (2) - AC/DC
                    ROT CONT PWR DIRECT (2) - MNA/MNB
        (TRIM)      BMAG MODE (3)-RATE 2
                    PRO
        (BYPASS)    BMAG MODE (3) - ATT1/RATE 2 (verify)
                    ENTR

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

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

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

        (REJECT)    ENTR

16      06 40   TFI, VG, ΔVM              (min-sec,.1fps)
                         *PROG ALM - TIG Slipped*
                         *V5N9E  01703          *
                         *KEY RLSE TO 16        *

                    FDAI SCALE - 5/5
                    LIMIT CYCLE - OFF
                    RATE - HIGH
                    UPDATE DET

   58:00
 (-02:00)           ΔV THRUST A(B) - NORMAL
                    THC - ARMED
                    RHC (2) - ARMED
                    SPS He vlvs (2) - AUTO (verify)
                    TAPE RCDR - HBR/RCD/FWD/CMD RESET

   59:25
 (-00:35)       DSKY BLANKS

   59:30        (AVE G ON)
 (-00:30)           EMS MODE - NORMAL
```

October 6, 1969
Basic Date Changed
CSM 1

```
        06 40   TFI,VG,ΔVM                    (min-sec,.1fps)
                CHECK PIPA BIAS <2fps for 5 sec

  59:XX         ULLAGE AS REQ
 (-00:XX)
                          *IF NO ULLAGE:        *
                          *DIR ULLAGE PB - PUSH*
                          *CONTROL ATT W/RHC    *

                MONITOR ΔVM (R3) COUNTING UP

  59:55
 (-00:05)
    F 99 40     ENG ON ENABLE REQUEST
          (AUTO IGN)      PRO AT TFI ≥0 Sec
          (BYPASS IGN)    ENTR to 19
                          EXIT - V37E 00E

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

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

* ΔV THRUST B(A) - NORMAL →*F 97 40 SPS Thrust fail    *
                          *(RESTART) PRO to IGN       *
                          *(RECYCLE) ENTR to TIG-05sec*

                     SPS THRUST Lt - ON
  00:03              ΔV THRUST B(A) - NORMAL
                          *IF SCS: +X & THRUST PB - PUSH*
                MONITOR THRUSTING
                  Pc 95-105 psia
                  EMS COUNTING DOWN
                       SPS INJ VLVS (4) - OPEN
                       SPS He vlvs tb-gray
                       SPS FUEL/OXID PRESS - 170-195 psia
                       PUGS - BALANCED
```

Basic Date October 6, 1969
Changed November 7, 1969

```
                    *PROG ALARM          *
                    *V5 N9E 01407 VG INC*
                    *LOI & TEI:          *
                    *  THC-CW, FLY MTVC *
                    *LOI 2 & MCC:        *
                    *  ΔV THRUST A&B-OFF*

00:XX       ECO

                    *EMER SPS CUTOFF:    *
                    *ΔV THRUST A&B - OFF*
                    *LOI - BT +10 sec    *
                    *LOI 2 - BT +1 sec   *
                    *TEI - BT +2 sec &   *
                    *   ΔV CTR <-40 fps *

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

19   F 16 85   VG XYZ (CM)                        (.1fps)
                 NULL RESIDUALS (TEI & MCC)
                 RECORD ΔV COUNTER & RESIDUALS ΔVC _____
                    EMS FUNC - OFF             VGX _____
                    EMS MODE - STBY            VGY _____
                    LIMIT CYCLE - On
                    ATT DB - MAX
                    TRANS CONT PWR - OFF
                    ROT CONTR PWR DIRECT (2) - OFF
                    BMAG MODE (3) - RATE 2
                    PCM BIT RATE - LOW
                 PRO
```

Basic Date October 6, 1969
Changed
CSM 10

20 F 37 V82E

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

R3-59B59HP >49.4 nm/35K ft

PRO

22 F 37 00E

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

BURN STATUS REPORT	
____ΔTIG	____VI
____BT	____HDOT
____VGX	____H
____R	____ΔVC
____P	____FUEL
____Y	____OXID
	____UNBAL
REMARKS	

P41 - RCS THRUSTING

Prethrust Program Complete
CMC - on
ISS - on
SCS - OPERATING
TEST C/W LAMPS
EMS MODE - STBY
EMS FUNC - ΔV SET/VHF RNG
Set EMS ΔV ind to 1586.8 fps
EMS MODE - NORMAL
EMS FUNCT - ΔV TEST
SPS THRUST lt - on/off (10 sec)
ΔV ind stops at - 0.1 to -41.5
EMS MODE - STBY
EMS FUNCT - ΔV SET/VHF RNG
Slew ΔV ind to -100 fps

EMS FUNCT - ΔV
EMS MODE - NORMAL
Wait 100 sec & record ΔV ind
If change to ind -
<1fps, no correction
>1fps, ground correction req
EMS MODE - STBY
EMS FUNCT - ΔV SET/VHF RNG
SET ΔVC
EMS FUNC - ΔV
BMAG MODE (3) - RATE 2
CMC MODE - FREE
AUTO RCS SELECT. (16) - As Req'd
LOAD DAP
ROT CONTR PWR NORMAL (2) - AC/DC
ROT CONTR PWR DIRECT (2) - MNA/B
DET SET
V37E 00E
SC CONT - CMC/AUTO

1 MNVR TO PAD BURN ATTITUDE
V62E

2 V49E

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

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

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

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

Basic Date October 6, 1969
Changed

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

8 V41 N91E

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

10 41 OPTICS DRIVE

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

11 V37E 41E

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

13 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)

14 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO TRIM) BMAG MODE (3) - RATE 2
ALIGN SC ROLL
SC CONT - CMC/AUTO
PRO To 13
(BYPASS) ATT DB - MIN
RATE - LOW
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/RATE 2
GDC ALIGN
ENTR

15 06 85 VG X,Y,Z (.1fps)

```
                    * PROG Alarm lt                 *
                    * V5N9E - 01703 - TIG SLIPPED *
                    * KEY RLSE To 15                *

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

  59:25
 (-00:35)           DSKY BLANKS

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

  00:00
17   F 16 85   VG X,Y,Z
               NULL COMPONENTS
               RECORD ΔV COUNTER & RESIDUALS    ΔVC_____
                    TAPE RCDR - off (ctr)       VGX_____
                    PCM BIT RATE - LOW
                    HAND CONTROLLERS - locked   VGY_____
                    EMS FUNC - OFF              VGZ_____
                    EMS MODE - STBY
                    TRANS CONT PWR - OFF
                    BMAG MODE (3) - RATE 2
               PRO

18   F 37      V82E

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

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

               PRO

20   F 37      00E

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

Basic Date October 6, 1969
Changed

CSM

P47 Thrust Monitor Program

CMC - on
ISS - on & aligned

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

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

		(RECYCLE)	V32E
		(TERM)	PRO
2	F 37	XXE	

Basic Date October 6, 1969
Changed

CSM 108

P51 - IMU ORIENTATION

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

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

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

3 F 51 PLEASE MARK
OPT ZERO - OFF
MARK

4 F 50 25 00016 TERMINATE MARKS
PRO

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

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

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

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

P52 IMU REALIGN

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

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

2 F 06 34 GET ALIGN (0,0, 0 initially)
(hr,min,.01sec)
Load desired GET
TO SPECIFY PRESENT TIME - PRO on (0,0,0)
PRO (NOM go to 4)

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

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

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

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

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

```
                                  *F 05 09 00405 NO PAIR    *
                                  *(CREW SPECIFY) PRO - to 8*
                                  *(PICAPAR) MNVR-V32E to 7 *

            (MAN ACQ) ENTR

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

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

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

            (MARK ROUTINE) OPTICS MODE - MAN

11 F 51         PLEASE MARK
                MARK

12    F 50 25   00016 TERMINATE MARKS
                PRO

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

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

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

(REJECT) V32E to 17
(ACCEPT) PRO

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

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

18 F 37
OPT ZERO - ZERO
XXE

P53 - BACKUP IMU ORIENT DETERMINATION

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

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

2 41 22 DESIRED GIMBAL ANGLES (0,0,0)
NO ATT 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

Basic Date October 6, 1969
Changed
CSM 108

```
5     F 50 25   00016 TERMINATE MARKS
            (REJECT)  ENTR to 4
                      PRO

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

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

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

P54 - BACKUP IMU REALIGN

```
                 CMC - on
                 ISS - on
                 SCS - operating
                 MAN ATT (3) - MIN IMP
                 COAS LOS DETERMINATION - complete

1                V37E 54E
      F 04 06    R1 00001  IMU ALIGN OPTION
                 R2 00001  PREF     PRO to 4
                        2  NOM      PRO to 2
                        3  REFSMMAT PRO to 7
                        4  LDG SITE PRO to 2

2     F 06 34    GET ALIGN (0,0,0 initially)
                                          (hr,min,.01sec)
                 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
```

October 6, 1969
Basic Date
Changed
CSM 108

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

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

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

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

          (MAN ACQ) ENTR

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

9     F 06 88   CELESTIAL BODY VECTOR
                Load desired vector
                PRO

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

11    F 53      PLEASE MARK
                Center Target
                ENTR

12    F 50 25   00016 TERMINATE MARKS
          (REJECT)  ENTR to 11
                PRO
```

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

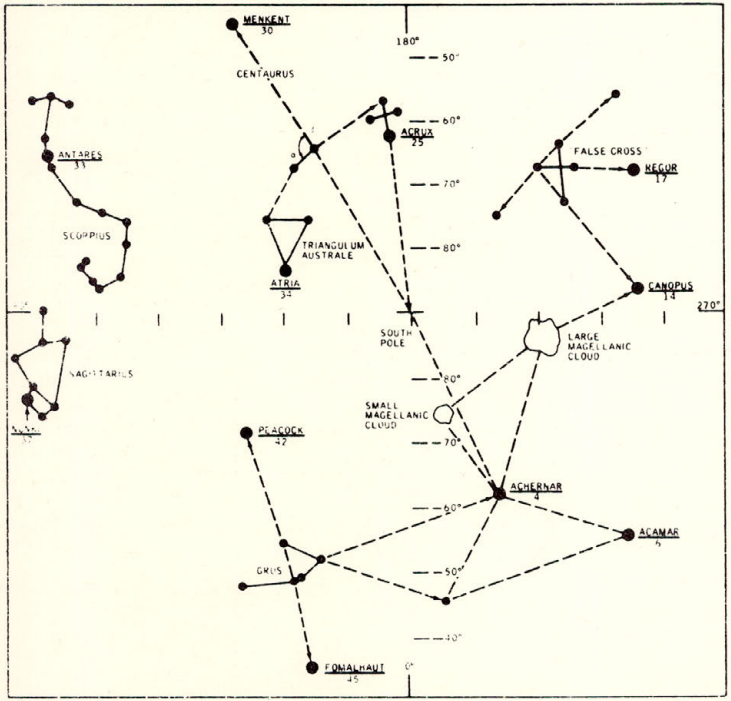
14 F 06 88 CELESTIAL BODY VECTOR
Load vector
PRO to 8 after 1st MARK
to 15 after 2nd MARK

15 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(REJECT) V32E to 17
(ACCEPT) PRO

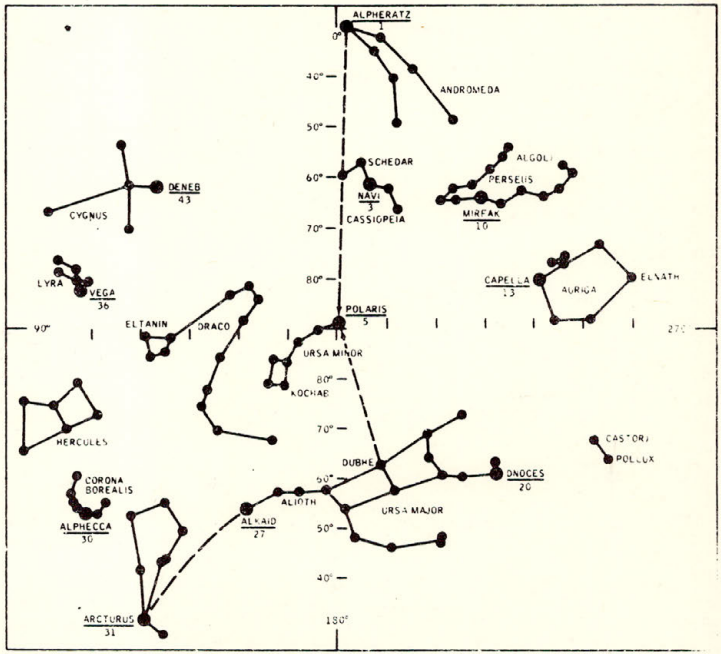
16 F 06 93 TORQUING ANGLES OG, IG, MG (.001°)
(TORQUE) CMC MODE - FREE
PRO
(BYPASS) V32E

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

18 F 37 XXE



SOUTHERN STARS

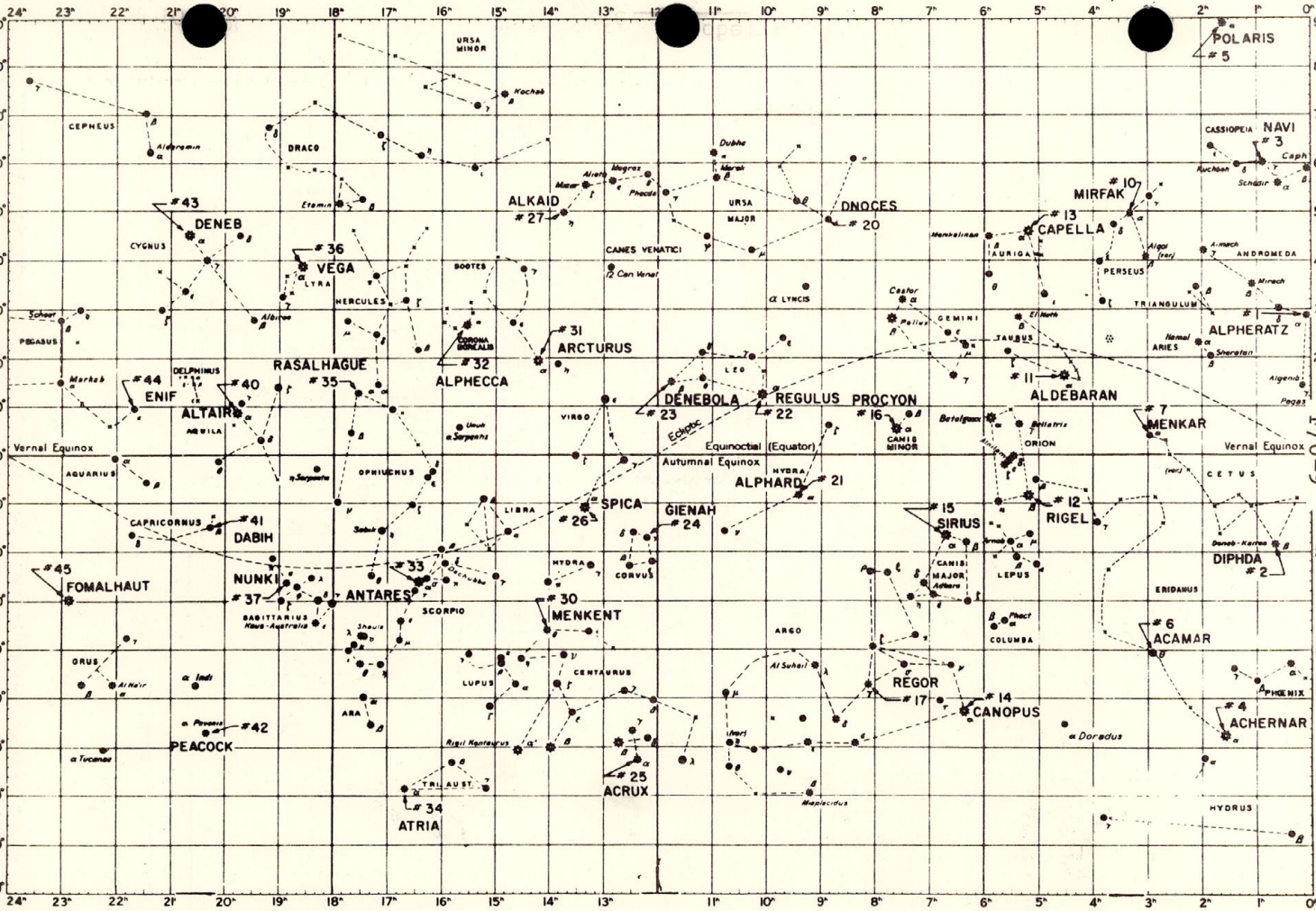


NORTHERN STARS

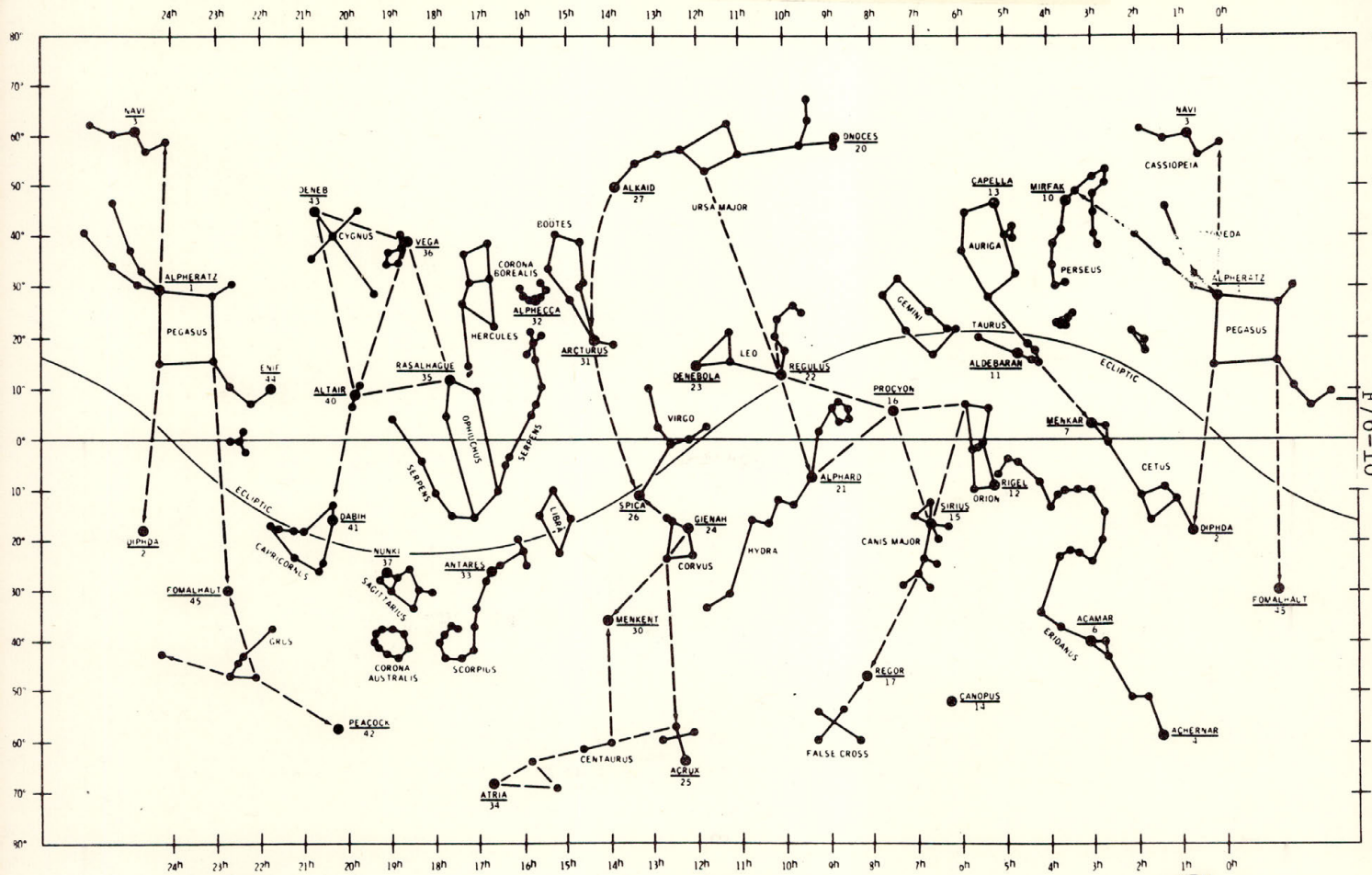
CSM 10

Basic Date ober 6, 1969

Changed


POLARIS
#5
NAVI
#3
CASSIOPEIA
MIRFAK
#10
#13
CAPELLA
DNOCES
#20
URSA MINOR
URSA MAJOR
ALKAID
#27
#43
DENEB
CYGNUS
#36
VEGA
LYRA
CANES VENATICI
BOOTES
HERCULES
CEPHEUS
DRACO
PEGASUS
#44
ENIF
#40
ALTAIR
AQUILA
DELPHINUS
RASALHAGUE
#35
CORONA BOREALIS
#32
ALPHECCA
#31
ARCTURUS
LEO
DENEBOLA
#23
REGULUS
#22
PROCYON
#16
CANIS MINOR
GEMINI
TAURUS
TAURIGA
PERSEUS
ANDROMEDA
TRIANGULUM
ALPHERATZ
ARIES
#11
ALDEBARAN
#7
MENKAR
ORION
RIGEL
#12
Vernal Equinox
Equinoctial (Equator)
Autumnal Equinox
Echoc
VIRGO
HYDRA
ALPHARD
#21
SPICA
#26
GIENAH
#24
LIBRA
OPHIUCHUS
SCORPIO
CAPRICORNUS
#41
DABIH
AQUARIUS
#45
FOMALHAUT
NUNKI
#37
SAGITTARIUS
ANTARES
#33
#30
MENKENT
CORVUS
CENTAURUS
LUPUS
ARA
#42
PEACOCK
TRI AUST
#34
ATRIA
#25
ACRUX
#15
SIRIUS
CANIS MAJOR
LEPUS
COLUMBA
REGOR
#17
#14
CANOPUS
ARGO
ERIDANUS
#6
ACAMAR
CETUS
DIPHDA
#2
PHOENIX
#4
ACHERNAR
HYDRUS
ORUS
F/69

Star Charts



F/6-10

CSM [illegible]B

Basic Date [illegible]ctober 6, 1969

Changed _____

P72 LM CSI TARGETING

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

RECORD
_____(hrs)
_____(min)
_____(sec)
PRO

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

RECORD
_____(APSIS)
_____(E)
(CENTANG)
PRO

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

RECORD
_____(hrs)
_____(min)
_____(sec)
PRO

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

```
*F 05 09                          *
* 00600 No Intersection on        *
*       First Iteration           *
* 00601 hp+CSI < 85nm/5.8nm       *
* 00602 hp+CDH < 85nm/5.8nm       *
* 00603 TIG(CDH)-TIG(CSI)<10min*
* 00604 TIG(TPI)-TIG(CDH)<10min*
```

Basic Date October 6, 1969
Changed

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

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

6    F 06 81   ΔV XYZ(LV) (CSI)                (.1fps)

               RECORD (Final Pass Only)
               ______(ΔVX)
               ______(ΔVY)
               ______(ΔVZ)
               V90E (correct out of plane velocity)
     F 04 12   R1  00002  Specify vehicle
               R2  00001  CSM
                   00002  LM
               PRO

     F 06 16   T EVENT

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

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

          PRO
```

7 F 06 82 ΔV XYZ(LV) (CDH) (.1fps)

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

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

9 F 37

P73 LM CDH TARGETING

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

RECORD
_____(hrs)
_____(min)
_____(sec)
PRO

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

```
*F 05 09 00611 NO TIG FOR    *
*              EL ANGLE      *
*  (CONTINUE P73) PRO To 3   *
*  (RECYCLE) V32E To 1 CHANGE*
*                      TIG   *
*  (TERMINATE) V34E To 6     *
```

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

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

4    F 06 81   ΔV XYZ(LV) (CDH)                  (.1fps)

               RECORD (Final Pass Only)
               ______(ΔVX)
               ______(ΔVY)
               ______(ΔVZ)
               V90E (correct out of plane velocity)
     F 04 12   R1  00002  Specify vehicle
               R2  00001  CSM
                   00002  LM
               PRO

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

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

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

               RECORD
               ______(Y)
               ______(YDOT)
               ______(PSI)
               PRO

          PRO
```

Basic Date October 6, 1969
Changed

5 F 16 45 M,TFI,MGA (marks,min-sec,.01°)
(RECYCLE) V32E To 3
(TERMINATE) PRO To 3
(FINAL PASS) SET EVENT TIMER TO TFI
PRO TRANSMIT PARAMETERS
TO LM (See Steps 1-4)

6 F 37

P76 - TARGET ΔV

1 V37E 76E
F 06 33 TIG (hrs,min,.01sec)
Load TIG
PRO

2 F 06 84 ΔV XYZ (.1fps)
Load ΔV
PRO

3 F 37 OOE

V82E (check LM parameters)

4 F 04 12 R1 00002 Specify vehicle
Load R2 = 00002
PRO

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

6 F 16 44 HA,HP,TFF (.1nm,min-sec)
R3 - 59B59HP > 49.4nm/35K ft
PRO

V35 - DSKY CONDITION LIGHT TEST

CMC - on

1 Key V37E 00E (required)
DSKY - P00

2 Key V35E

3 Monitor the following events

a. All DSKY condition lts - on

b. ISS warning lt - on
CMC warning lt - on

c. All DSKY numerical windows display "8". Sign positions in R1,R2, R3 show +, V, N windows flash

Wait 5 sec

d. All DSKY warning lts - off

e. ISS lt - off
CMC lt - off

f. P00 will be displayed.

g. Key RSET

V41 N91 COARSE ALIGN OCDU's

CMC - on
ISS - on
G/N PWR OPTICS - on
OPT MODE - CMC
OPT ZERO - OFF

1 V41N 91E

2	F 21 92	SHAFT, TRUN NEW OCDU Load desired shaft and trun	(.01°,.001°)
3	41	OPTICS DRIVE TO SPECIFIED ANGLES	
		<u>V41 N20 COARSE ALIGN ICDU's</u> CMC - on ISS - on	
1		V41N 20E	
2	F 21 22	NEW ICDU ANGLES RPY Load desired ICDU angles	(.01°)
3	41	NO ATT lt - on *POSS PROG ALARM * *V5 N9E 211 Coarse align error* *Repeat V41 N20 *	
4		V40 N20E NO ATT lt - off Wait 20 sec	
5		V37E XXE	
		<u>V42 GYRO TORQUING</u> CMC MODE - FREE	
1		V42E	
	F 21 93	LOAD DELTA GYRO ANGLES (XYZ) (In flight - 90° max)	(.001°)
2	42	NO ATT lt - off Monitor Gyro Torquing on FDAI	

V48 - DAP DATA LOAD & ACTIVATE PROCEDURE

1 V48E

F 04 46 R1 ABCDE*
R2 ABCDE

	VEHICLE CONFIG	QUAD A/C FOR $\ddot{X}$	QUAD B/D for $\ddot{X}$	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 = $\pm$ 0.5° 1 = $\pm$ 5.0°	0 = 0.05°/sec 1 = 0.2°/sec 2 = 0.5°/sec 3 = 2.0°/sec
	Roll Quad Select	Quad A	Quad B	Quad C	Quad D
R2	0 = Use B/D 1 = Use A/C	0 = Fail 1 = Use	0 = Fail 1 = Use	0 = Fail 1 = Use	0 = Fail 1 = Use

PRO

2 F 06 47 CSM WT, LM WT (lbs,lbs)
Load correct values*
PRO

3 F 06 48 TRIM ENGINE GMBL (.01°)
Load correct values
PRO

4 If activation req'd:
CMC MODE - FREE
V46E

* For SPS burn w/Ascent Stage, A=1, & load total mass

V49 CREW DEFINED MANEUVER

CMC - on
ISS - on
SCS - operating

1 V37E 00E
V62E

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

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

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

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

V55 - CMC TIME UPDATE

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

V64 HI GAIN ANTENNA POINTING

1 V64E
F 06 51 RHO, GAMMA (.01°,.01°)
HGA TRACK - MAN
Set in required P&Y Angles
S BD ANT - HI GAIN
HGA TRACK - AUTO
PRO

V67 - W-MATRIX ERROR DISPLAY

1 V67E

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

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

Load desired data

To reinitialize Cislunar W-matrix,

Load: R1 +30000
R2 +00330
R3 +00003

PRO

V74 CMC DOWNLINK

1 V74E (Places erasable memory on downlink)

V79 - DAP PTC/Orb rate

PTC - pg F/9-6
Orb rate - page F/2-6

V82 ORBIT PARAMETER DISPLAY

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

```
1              V82E (If AVE G On, Go To 2)
   F 04 12     R1 00002 Specify Vehicle
               R2 00001 CSM
                  00002 LM
               PRO

2  F 06 16     GET EVENT                    (hrs,min,.01sec)
               Load desired time (present time,
                                  use all zeroes)
               PRO

3  F 16 44     HA, HP, TFF            (.1nm,.1nm,min-sec)
      (RECYCLE)  V32E to 3 (Not Nec If AVE G On)
      (ΔR-miss dist DISP-P11 & POO) N50E to 4
      (TF PER)  N32E to 5
      (EXIT)    PRO

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

5  F 16 32     TIME FROM PER (Useful only if TFF=-59B59)
                                          (hrs,min,.01sec)
               KEY RLSE To 3
```

V83 RNDZ PARAMETER DISPLAY #1

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

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

V85 - RNDZ PARAMETER DISPLAY #2

Note: See V83 restrictions

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

V87 - SET VHF RNG FLAG

VHF AM B - DUPLEX
VHF RNG - on (up)
P20 - running

1 V87E (starts VHF range sampling)

2 V88E (TERMINATE)
or V37E XXE

V89 - RENDEZVOUS FINAL ATTITUDE

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

```
1                V37E 00E
                 V62E

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

3   F 06 18      FINAL FDAI RPY ANGLES                (.01°)
         (AUTO MNVR)  PRO
         (UPDATE DISPLAY)  V32E

4   F 50 18      REQ MNVR TO FDAI RPY ANGLES          (.01°)
         (AUTO)       BMAG MODE (3) - RATE 2
                      SC CONT - CMC
                      CMC MODE - AUTO
                 PRO
         (MAN)        MNVR To 6

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

6   F 50 18      REQ MNVR TO FDAI RPY ANGLES          (.01°)
         (TRIM)       ALIGN SC In ROLL
                 PRO To 5
         (BYPASS)     ENTR
```

V90 - OUT-OF-PLANE DISPLAY

```
1                V90E
     F 04 12     R1  00002  Specify Vehicle
                 R2  00001  CSM
                     00002  LM
                 PRO

2    F 06 16     GET EVENT                (hrs,min,.01sec)
                 Load desired time
                 PRO

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

V91 - COMPUTE BANKSUM

CMC - on (req)

```
1                V37E 00E

2                V91E
     F 05 01     R1 - Sum of all cells in bank
                 R2 - Bank number
                 R3 - Bugger word
                 Verify R1=R2 or R1+R2=77777 (If not, rcd R2)
          (NEXT BANK)  PRO
          (TERM)       V34E
```

V93 - ENABLE W-MATRIX INITIALIZATION

```
1                V93E
```

SCS POWER UP

AUTO RCS SELECT (16) - OFF
BMAG MODE (3) - RATE 2
CMC MODE - FREE
SC CONT - CMC
cb SCS LOGIC PWR (4) - close
ΔV CG - as required
LOGIC PWR 2/3 - on (up)
SIG COND/DRIVER BIAS PWR (2) - AC1
SCS ELEC PWR - GDC/ECA (88 watts)
FDAI PWR - OFF (verify)
BMAG PWR (2) - ON (145 watts)
FDAI PWR - BOTH (58 watts)
AUTO RCS SELECT (16) - enable

SCS POWER DOWN

EMS FUNCTION - OFF
EMS MODE - STBY
FDAI SCALE - 5/1
FDAI SELECT-1/2
FDAI SOURCE - ATT SET
ATT SET - GDC
MAN ATT (3) - MIN IMP
ATT DB - MAX
RATE - LOW
AUTO RCS SELECT (16) - OFF
TRANS CONTR PWR - OFF
RHC PWR NORMAL (2) - OFF
RHC PWR DIRECT (2) - OFF
CMC MODE - FREE
BMAG MODE (3) - RATE 2
SCS TVC (2) - RATE CMD
.05G sw - OFF
α/Pc sw - Pc
TVC GMBL DRIVE (P&Y) - AUTO
BMAG PWR (2) - WARMUP (105 watts)
TVC SERVO PWR (2) - OFF
FDAI PWR - OFF
LOGIC PWR 2/3 - OFF
SCS ELEC PWR - OFF
SIG COND/DRIVER BIAS PWR (2) - OFF

GDC ALIGNMENT TO IMU GIMBAL ANGLES

IMU - on
SCS - operating

1 Damp vehicle rates

2 ATT SET dials - set to IMU angles on FDAI 1
FDAI SELECT - 1
FDAI SOURCE - ATT SET
ATT SET - IMU
ATT SET dials - null FDAI 1 err needles
ATT SET - GDC
GDC ALIGN PB - push until needles nulled
FDAI SEL - 1/2

SCS ATTITUDE REFERENCE COMPARISON

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

1 Key V16 N20E (press IMU angs)

2 FDAI SELECT - 1
FDAI SOURCE - ATT SET
ATT SET - GDC
ATT SET dials - null FDAI 1 error needles
Key VERB when nulled (freeze display)
Record from DSKY:
R_____°, P_____°, Y_____°
Record ATT SET dials:
R_____°, P_____°, Y_____°

BACKUP GDC &/or IMU ALIGNMENT (CMC FAILED)

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

1 Set SCT to 0° SHFT, 352.5° TRUN

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

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

4 MNVR to STARS
R line - Rigel (12)
30° mark - Sirius (15)

or

	NORTH	SOUTH
R line -	Polaris (5)	Atria (34)
30°mark -	Navi (3)	Acrux (25)

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

6 ATT SET dials - 0,0,0

7 MNVR to 0,0,0 and null error needles

8 UNCAGE IMU
FDAI SELECT - 1/2

Basic Date October 6, 1969
Changed November 7, 1969

IN-PLANE GDC ALIGNMENT

CMC - on
ISS - on
SCS - operating

1		V37E 52E
	F 04 06	00001
		Load R2=00002
		PRO
2	F 06 34	GET ALIGN 0,0,0
		PRO
3	F 06 22	R,P,Y
4		Set ATT SET dials to R,P,Y on DSKY
5		FDAI SELECT - 1 ATT SET - GDC GDC ALIGN - push
6		V37E XXE

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

1		FDAI 1 or 2 - ORB RATE EARTH/LUNAR - as req'd
2		V82E
	F 04 12	00002 SPECIFY VEHICLE
		00001
		PRO
3	F 06 16	GET EVENT (hrs,min,.01sec)
		PRO

4	F 16 44	HA, HP	(.1nm,.1nm)
		Calculate Average	
		ALT SET - Set Average	
		PRO	
5		V83E	
	F 16 54	R,RDOT,THETA	(.01nm,.1fps,.01°)
		MODE - HOLD/FAST	
		SLEW - To THETA	
		MODE - OPR/SLOW	
		PRO	

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

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

2 MSFN Supply Altitude
ALT SET - Set

3 SC +X At the Horizon

4 MODE - HOLD/FAST
SLEW FDAI
MODE - OPR/SLOW

COAS LOS DETERMINATION

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

1 V37E 52E

2 F 04 06 00001
V22E 3E
PRO

3 F 50 25 00015
ENTR

4 F 01 70 000DE STAR CODE
LOAD BORESIGHT STAR CODE
OPT ZERO - OFF
PRO (Ignore PROG ALARM)

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

PASSIVE THERMAL CONTROL (G&N)

RHC - Locked
FDAI SCALE - 5/1

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

2 F 06 22 Load PTC Attitude R - present
P - 90° (TLC) or 270° (TEC)
Y - 0°
PRO

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

4 06 18 AUTO MANEUVER
F 50 18

5 Damp vehicle rates:
ENTR
Disable all jets on two adjacent quads
Wait 20 minutes for rates to damp
MAN ATT (PITCH & YAW) - ACCEL CMD

6 V79E

7 F 06 79 Rate,Deadband,Code(.0001°/sec,.01°,+XXXXX)

Load desired values in R1 and R2
and +00000 in R3

Enable all jets
PRO

8 MAN ATT (ROLL) - ACCEL CMD
MAN ATT (PITCH & YAW) - RATE CMD

9 To disable RCS:
AUTO RCS SEL (16) - OFF
ROT CONTR PWR DIR (2) - OFF

To exit G&N PTC

1. AUTO RCS SEL (12) - MNA/B
   MAN ATT (3) - ACCEL CMD
2. Verify DAP load
3. Select new desired att:
   V49E
   F 06 22 New ICDU angles
   SC CONT - SCS, then CMC
   PRO
   F 50 18

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

For simple termination:
SC CONT - SCS
AUTO RCS SEL (12) - MNA/B
MAN ATT (3) - RATE CMD

Basic Date October 6, 1969
Changed October 27, 1969

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

1 MNVR TO PTC ATT
V62E

2 V49E

3 F 06 22 DESIRED FINAL GMBL ANGLES (.01°)
LOAD R,P,Y PTC
PRO

4 F 50 18 REQ MNVR TO FDAI R,P,Y ANGLES (.01°)
(AUTO) SC CONT - CMC
CMC MODE - AUTO
PRO
(MAN) SC CONT - SCS
MNVR to 6

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

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

7 Initiate desired roll rate

8 TERMINATE PTC

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

CMC/LGC CLOCK SYNC/TEPHEM UPDATE
V16 N65E (On LM request)
(hr,min,.01sec)
Voice CMC time to LM
V05 N01E 1706E (On LM request)
Voice TEPHEM to LM

DOCKED IMU ALIGN
ATT DB - MIN
SC CONT - SCS
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/RATE 2
V06 N20E
Voice ICDU angles to LM
Terminate attitude hold on LM cmd
V06 N20 (On LM request)
On LM MARK, Key ENTR
Copy ICDU angles and transmit to
MSFN

Basic Date October 6, 1969
Changed
CSM 108

SYSTEMS MANAGEMENT

PROPULSION SYSTEM

1 SPS MONITORING CHECK

SPS PRPLNT TK TEMP ind - +45 to +75°F
*IF<45°F, SPS LINE HTRS - A *
IF>75°F, SPS LINE HTRS - off (ctr)
SPS PRESS IND sw - He, N2A, & N2B
SPS PRPLNT TK PRESS ind
He 3900 psia max
N2A 2900 psia max
N2B 2900 psia max
SPS PRESS IND sw - He
FUEL & OXID PRESS ind - 170 to 195 psia
SPS ENG INJ VLVS (4) - CLOSE
SPS OXID, FUEL & UNBAL QTY - record
OXID FLOW VLV PRIM - PRIM
SPS He VLV (1&2) - AUTO, tb - bp

2 SM RCS MONITORING CHECK

SM RCS PRPLNT tb (8) - gray
SM RCS He 1 & 2 tb (8) - gray
RCS IND sel - SM A, B, C, D
PKG TEMP - 115°-175° F (C/W 75°-205°)
He PRESS - record
MANF PRESS - 178-192 psia (C/W 145-215 psia)
He TK TEMP - record
PRPLNT QTY - record
When MANF PRESS <150 psia
RCS SEC FUEL PRESS A (B, C, D) - OPEN

3 CM RCS MONITORING CHECK

CM RCS PRPLNT tb (2) - bp
RCS IND sw - CM 1,2
He TEMP - 60-90°F
He PRESS - 4100-4200 psia
MANF PRESS - 80-105 psia

Basic Date October 6, 1969
Changed October 27, 1969

EPS SYSTEM

1 Cryogenic Pressure - Quantity Check

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

2 FC Power Plant Check

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

3 D-C Voltage-Amperage Check

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

4 A-C VOLTS - 113 to 117 all phases

5 Battery Charging BAT A(B)

MAIN BUS TIE A/C (B/C) - OFF
cb BAT BUS A & B PYRO BUS TIE - open (verify)
cb BAT C BAT BUS A & B - open (verify)

Basic Date October 6, 1969
Changed

cb BAT RLY BUS BAT A(B) - open
DC IND sel - BAT CHARGER
BAT CHARGE - A(B,C)
DC VOLTS - 37.5-39.5 vdc
BAT CHARGE - OFF at 39.5 vdc or 100% recharge
cb BAT RLY BUS BAT A(B) - closed
SYS TEST - 4A (BAT VENT <1.5)
If >1.5: BAT VENT vlv -
VENT (to ∿0) then CLOSED
SYS TEST - 4B

6 Fuel Cell Power Plant Purging

A. O2 PURGING
FC IND sw - 1(2,3)
FC PURGE 1(2,3) - O2 (2 min.)
FC FLOW - O2 Flow incr 0.6 lb/hr
M/A FC 1(2,3) - On/RSET
FC PURGE - 1(2,3) - OFF

B. H2 PURGING
H2 PURGE LINE HTR - ON, 20 min prior to purge
FC IND sw - 1(2,3)
FC PURGE 1(2,3) - H2 (1 min, 20 sec)
FC H2 FLOW - Flow incr 0.67 lb/hr
(will exceed C/W limit)
M/A FC 1(2,3) - On/RSET
FC PURGE - 1(2,3) - OFF
After 10 minutes:
H2 PURGE LINE HTR - OFF

7 H2 or O2 Quantity Balance Correction

ON LOW Tank, H2 or O2 HTRS 1(2) - OFF,
THEN AUTO, WHEN BALANCED

8 FUEL CELL SHUTDOWN (APPLICABLE FC)

cb FC REACS - close
cb FC PURGE - open
FC REAC - OFF
FC HTRS - OFF
FC PUMPS - OFF
cb FC PUMPS AC - open

Basic Date October 6, 1969
Changed

AT Tskin $\leq$200° F
H2 PURGE LINE HTR - ON (for 30 min)
cb FC PURGE - close
FC PURGE - 02 (TIL 02 PRESS = N2 PRESS)
FC PURGE - H2 (TIL PRESS STABILIZES)
FC PURGE - OFF
H2 PURGE LINE HTR - OFF
cb FC PURGE - open

9 FUEL CELL SWITCHING

PRIOR TO DISCONNECTING, INSURE THAT AT LEAST ONE FUEL CELL IS POWERING EACH MAIN BUS

Possible MA & FC DISCONNECT lt

10 INVERTER CHANGEOVER

A. One inverter on each AC bus at all times (if available)

B. If all three AC bus ties for the same bus are on, inverter power to that bus may be lost

C. When switching DC power on inverter 3, pause in OFF position

11 CRYO 02 & H2 MANUAL FAN OPERATION

H2 & 02 FANS - ON (seq at 1 sec intervals for 1 min each)

a. Prior to every SPS or SIVB ΔV
b. Presleep
c. Postsleep

CAUTION

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

ECS PERIODIC VERIFICATION

1 ECS MONITORING CHECK

CABIN ΔP - -1 to -3.5 in H20
02 FLOW - 0.2-0.45 lb/hr (after changeover)
02 SURGE TANK PRESS - 865-935 psia
REPRESS 02 >865 psia
PRIM RAD tb - gray

Basic Date October 6, 1969
Changed
CSM

*If PRIM RAD tb - 2 *
* ECS RAD FLOW AUTO CONT - 1 until *
* tb gray, then AUTO *

ECS RAD TEMP PRIM IN - 67-97° F
ECS RAD TEMP PRIM OUT - -20° to +63° F (-20° to 97° F for lunar orb)
PRIM GLY EVAP TEMP OUT - 38-50.5°F
PRIM GLY EVAP STEAM PRESS
.09-.15 boiling, > .16 not boiling
PRIM GLY DISCH PRESS - 40-52 psig
SUIT TEMP - 45-55° F
CABIN TEMP - 70-80° F
SUIT PRESS/CABIN PRESS- 4.7-5.3 psia
PART PRESS CO_2 < 7.6 mm Hg
SUIT COMP ΔP - 0.3-0.4 psid
PRIM GLY ACCUM QTY 30-65%
*If <30% - PRIM ACCUM FILL vlv - *
* ON (Until 40-55%) *
POT H_2O QTY - 10-100%
WASTE H_2O QTY - 25-85%
If >85% - Dump

2 ECS PERIODIC REDUNDANT COMPONENT CK

Suit Compressor
Sw to other compr
SUIT COMPR ΔP ind - 0.3-0.4 psid
Main O_2 Regulators
MAIN REG B vlv - close
EMER CABIN PRESS sel - 1
PUSH TO TEST PB - PUSH (O_2 FLOW INC)
MAIN REG B vlv - open
MAIN REG A vlv - close
EMER CABIN PRESS sel - 2
PUSH TO TEST PB - PUSH (O_2 FLOW INC)
MAIN REG A vlv - open
EMER CABIN PRESS sel - BOTH (OFF if all suited)
Secondary Glycol Loop
Open cool atten panel (If req'd)
EVAP H_2O CONT SEC vlv - AUTO
ECS IND sw - SEC

Basic Date October 6, 1969
Changed
CSM 108

SEC COOL LOOP PUMP - AC 1 (AC 2)
GLY DISCH SEC PRESS - 39-51 psig
ACCUM SEC QTY IND - 30-55%
SEC COOL LOOP EVAP - EVAP
SEC EVAP STEAM PRESS .09-.15 boiling,
>.16 not boiling

After 5 min
SEC EVAP TEMP OUT - 38-50.5°F
SEC COOL LOOP EVAP - RESET for 1 min minimum,
then off (ctr)
SEC COOL LOOP PUMP - off (ctr)
ECS IND sw - PRIM

3. CO2 ABSORBER FILTER REPLACEMENT

Open CO2 Canister attenuation pnl

CAUTION

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

CO2 CSTR DIVERT vlv - up (or dn)

CAUTION

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

CANISTER MANUAL BLEED vlv - PRESS
COVER LATCHING HANDLE - UNLOCK
Replace used filter
COVER LATCHING HANDLE - LOCK
CO2 CSTR DIVERT vlv - ctr
Close CO2 Canister attenuation pnl
SHIM Stowage - B5 & B6

4 DEBRIS SCREEN CHECK
Check SUIT RET AIR vlv screen
SUIT RET AIR vlv - CLOSE (push)
Clean screens
SUIT RET AIR vlv - OPEN (pull)

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

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

7 DONNING PGA (with helmet & gloves)
SUIT PWR - OFF for comm cable connect
PWR - OFF
AUDIO CONT - NORM
Connect supply and return hoses to PGA
Connect COMM control head to PGA
SUIT FLOW vlv - FULL FLOW (for suited crewman)
SUIT RET AIR vlv - CLOSED (push)
EMERG CABIN PRESS vlv - OFF

8 PARTIAL SUIT CKLIST
EMER CAB PRESS vlv - BOTH
SUIT CKT RET vlv - OPEN (pull)
Reverse O2 umbilicals
Before disconnecting umbilical from head set:
SUIT PWR - OFF
POWER - OFF
AUDIO CONT - NORM

Basic Date October 6, 1969
Changed
CSM 108

9 URINE DUMP MODES

USING UTS

A PGA URINE COLL BAG DUMP

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

B UTS (Collection)

Obtain UTS & verify vlv - CLOSED
Attach UTS - open vlv - Perform task
UTS vlv - CLOSED
Disconnect UTS & stow

C UTS (Dump)

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

USING URINE RECEPTACLE ASSY (URA)

Connect urine line filter to urine transfer hose.
Connect urine transfer hose/filter to urine feces QD
Connect Urine Receptacle/Plenum Assy to urine transfer hose
WASTE MGMT DRAIN vlv - DUMP
URA vlv - VENT

Basic Date _____
Changed _____

NOTE: Direct water stream parallel to Honeycomb to prevent splash-back. Avoid acceleration to URA during use. Remove last drop by touching screen at top of URA.

Perform task
Flush screen and Honeycomb
  with water gun
Replace Receptacle cover
URA vlv - CLOSE after particles cease
  exhausting vent line (1 to 2 minutes)
WASTE MGMT DRAIN vlv - CLOSE
Stow Urine Receptacle/Plenum Assy.

10 CABIN PRESSURIZATION

A NORMAL 30 min
CAB PRESS REL vlv (2) - NORMAL (latch on)
REPRESS PKG vlv - FILL
02 PRESS ind - SURGE TK
REPRESS 02 vlv - OPEN
If SURGE TANK PRESS decreases to 150 psia:
* REPRESS 02 vlv - CLOSE *
CAB PRESS ind - ≈3.0 psia (1 min)
REPRESS PKG vlv - OFF
CAB REPRESS vlv - OPEN (CW), Adjust to maintain
≥ 150 psia in SURGE TANK
REPRESS 02 PRESS ind - ≈0 psia
REPRESS 02 vlv - CLOSE
CAB PRESS = 4.7-5.3 psia
CAB REPRESS vlv - OFF

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

October 6, 1969
Basic Date
Changed
CSM 108

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

CAUTION

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

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

SUIT TEST vlv - PRESS
O2 FLOW - 1.0 lb/hr (pegged)
O2 FLOW HI lt - on
M/A - ON, Reset
SUIT PRESS - 8.8-9.8 psia
PGA PRESS - 4.1-4.5 psig
O2 FLOW HI lt - out
Allow O2 flow to stabilize 15 sec
O2 flow will remain below 0.8 lb/hr for 30 sec after stabilization
SUIT TEST vlv - DEPRESS
O2 FLOW - 0.2-0.4 lb/hr
SUIT PRESS - slightly > CAB PRESS
SUIT TEST vlv - OFF
O2 DEMAND REG vlv - BOTH (verify)

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

Basic Date October 6, 1969
Changed
CSM 008

CAUTION

see pg 10-10

SUIT TEST vlv - PRESS
  O2 FLOW - 1.0 lb/hr (pegged)
  O2 FLOW HI lt - ON
  M/A - ON, Reset
  SUIT PRESS - 8.8-9.8 psia
  PGA PRESS - 4.1-4.5 psig

WARNING

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

SUIT FLOW vlv - OFF
  Monitor for <0.5 psi/min decay
SUIT FLOW vlv - SUIT FULL FLOW
SUIT TEST vlv - DEPRESS
  O2 FLOW HI lt - out
  O2 FLOW - 0.2-0.4 lb/hr
  SUIT PRESS - slightly > CAB PRESS
SUIT TEST vlv - OFF

13 CM PRESSURE DUMP
EMER CABIN PRESS vlv - OFF (verify)
CAB REPRESS vlv - OFF (verify)
SUIT RTN AIR vlv - CLOSED (verify)
CABIN FANS (2) - OFF (verify)
DIR O2 vlv - CLOSE
CAB PRESS REL vlv (RH) - DUMP (latch off)
CABIN PRESS - 3.0-3.25 psia
  CAB PRESS REL vlv (RH) - BOOST ENTRY
  O2 FLOW - 0.24 lb/hr
  SUIT PRESS - 3.5-4.0 psia
CAB PRESS REL vlv (RH) - DUMP
  CABIN PRESS - 0.0 psia (within 6 min)
CAB PRESS REL vlv (2) - NORMAL (latch on)

Basic Date October 6, 1969
Changed
CSM 108

14 SUIT CKT H2 PURGE

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

15 CABIN COLD SOAK

ACTIVATE

SUIT HT EXCH SEC GLY vlv - FLOW
EVAP H2O CONT SEC vlv - AUTO
GLY TO RAD SEC vlv - BYPASS (verify)
SUIT CKT HT EXCH - BYPASS (20sec), then OFF
ECS IND sel - SEC
SEC COOL LOOP PUMP - AC2
GLY DISCH SEC PRESS - 39-51 psig
SEC ACCUM QTY - 30-55%
SEC COOL LOOP EVAP - EVAP
SEC GLY EVAP OUT TEMP - 38-50.5°F
SEC GLY EVAP STM PRESS - .09-0.15 psia,
  >.16 not boiling
ECS IND - PRIM
PRIM ECS RAD OUT TEMP - >-20°F
  IF <-20°F, DEACTIVATE

DEACTIVATE

SUIT CKT HT EXCH - ON (20 sec), then OFF
SEC COOL LOOP EVAP - RESET 1 min min, then OFF
SEC COOL LOOP PUMP - OFF
EVAP H2O CONT SEC vlv - OFF (AUTO for ENTRY)

16 ACTIVATE PRIMARY EVAP

GLY EVAP H2O FLOW - AUTO
GLY EVAP STM PRESS - AUTO

DEACTIVATE PRIMARY EVAP

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

Basic Date October 6, 1969
Changed
CSM 008

PRIM EVAP RESERVICE

GLY EVAP STM AUTO - MAN
GLY EVAP STM INCR - INCR
for 1 min
Wait 15 min
GLY EVAP H20 FLOW - ON
for 2 min, then AUTO
GLY EVAP STM AUTO - AUTO

17 ACTIVATE SEC EVAP

SEC EVAP H20 CONT - AUTO
SEC COOL LOOP EVAP - EVAP
SEC COOL LOOP PUMP - AC1

DEACTIVATE SEC EVAP

SEC COOL LOOP EVAP - RESET for 1 minute
SEC EVAP H20 CONT - OFF
SEC COOL LOOP PUMP - OFF

18 POTABLE WATER CHLORINATION

Check WASTE TK qty; if <15%,
no chlorination if evaporators operating.
Check POT TK qty; if >90°;
withdraw 8 oz of water
Unstow chlorination unit
Remove chlor port cap
Attach needle assembly to injection port
Insert chlorine ampoule into casing
Connect knob assembly & rotate (CW) until
piston contacts ampoule
Install ampoule assembly on needle assembly
(push & turn CW)
Rotate knob (CW) until ampoule is empty
(3 times for half empty if H20 quantity <50%)
Disconnect ampoule assembly from needle
assembly
Rotate knob CCW & stow used ampoule
Repeat above steps with buffer ampoule
POT TK IN vlv - OPEN (verify)
Wait 10 min & remove ampoule of H20
Replace chlor port cap
Stow chlorination unit
Do not drink for 30 min

October 6, 1969
Basic Date
Changed
CSM 108

19 WASTE WATER TANK DRAIN

H20 QTY IND sw - WASTE
POTABLE TANK INLET - CLOSE
WATER CONT PRESS REL vlv - DUMP A
Monitor H20 QTY (WASTE) ind - decreasing
When H20 QTY (WASTE) ind reads 25%:
  WATER CONT PRESS REL vlv - 2
POTABLE TANK INLET - OPEN

20 SIDE HATCH URINE/WATER DUMP

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

21 WATER COLLECTION

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

22 WATER/GAS SEPARATOR SERVICING

Remove separators from stowage
Attach a separator to water pistol
Trigger water pistol in short pulses until water is
  observed at separator outlet post

Basic Date October 6, 1969
Changed
CS 08

Wait 10 minutes
CAUTION - Membrane can be damaged by pencils, screwdrivers, and other pointed objects
Remove separator and place on food preparation unit (Lock in place)
Perform same procedure for second unit and leave on water gun

23 PRE LOI SEC GLY LOOP CHECK
ECS IND sw - SEC
SEC GLY TO RAD vlv - NORM
SEC COOL LOOP PUMP - AC1
GLY DISCH SEC PRESS - 39-51 psia
ACCUM SEC QTY ind - 30-55%
SEC EVAP TEMP OUT - decreases (verifies flow)
SEC COOL LOOP PUMP - OFF (ctr)
SEC GLY TO RAD vlv - BYPASS
ECS IND sw - PRIM

24 CONTAMINATION CONTROL
Note: If water to be collected, use water collection procedure.
SUIT RET vlv - close
DEMAND REG - OFF
ALL FLOW vlvs - FULL FLOW
Install interconnect on L O2 red hose
Install vacuum cleaner brush on R O2 red hose
Install screen on C O2 red hose
Vacuum/brush CM interior with special attention to the following:
Transfer tunnel wall and top hatch surfaces
Open B5 and B6 cover and clean compartment and SRC bags surfaces
Open A5 and clean compartment and CSC bag and film cassette bags surfaces
Open R13 and clean compartment and film magazine bag surface
Open food containers and clean compartment and helmet stowage bags surfaces
PGA bag surfaces
Move vacuum cleaner brush into all potential "dead air" pockets to ensure thorough scrubbing of CM atmosphere by LiOH canisters

Basic Date October 6, 1969
Changed
CSM 108

Change routing of hoses to establish new 02 flow pattern in CM for next 24-hour period
SUIT RET vlv - OPEN
DEMAND REGS - BOTH

C/W SYSTEM

A C/W SYSTEM OPERATIONAL CHECK
C/W LAMP TEST-1 (LH MA & 15 lts)
C/W LAMP TEST-2 (RH MA & 20 lts)
C/W CSM-CM (CM RCS lt(2)-on)
C/W CSM-CSM(CM RCS lt(2)-out)

B ACKNOWLEDGE/RESET MASTER ALARM INDICATION

a. Normal mode
MA tone/lt(3)-on
MA pb/lt(1)-push
MA tone/lt(3)-out
applicable C/W lt remains on

b. Acknowledge mode (C/W NORM in ACK)
MA tone/lt(3)-on
MA pb/lt(1)-push & hold
MA tone/lt(3)-out
applicable C/W lt remains on for malfunction indication
MA pb/lt -release
applicable C/W lt -out

C MASTER ALARM TONE HEADSET CONTROL

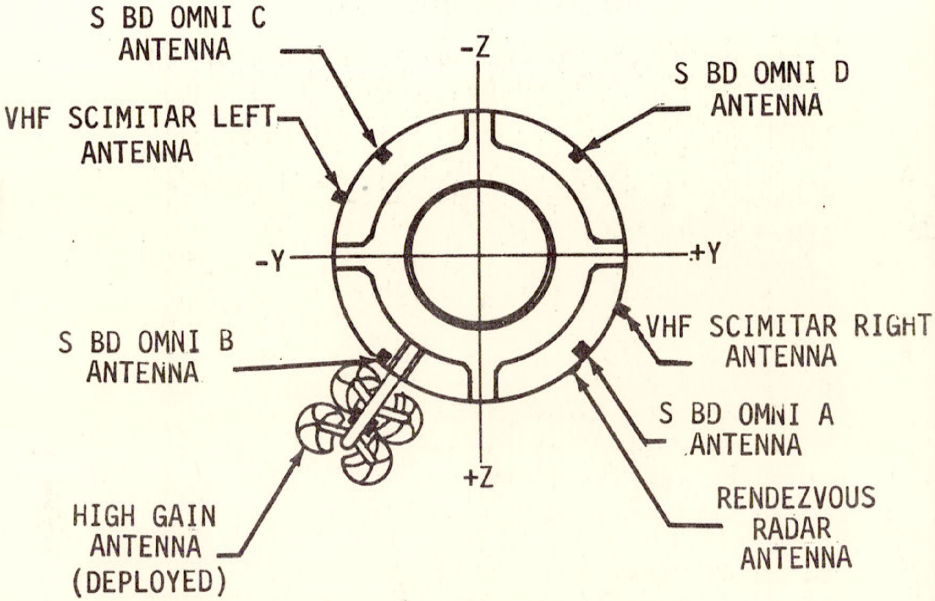
a. Inhibit tone (PWR-AUDIO)

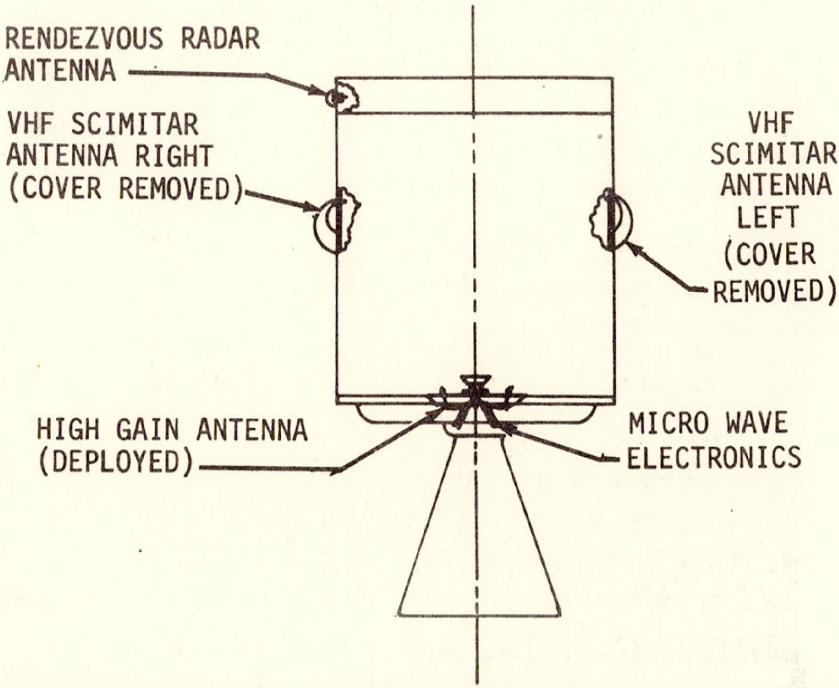
b. Permit tone (PWR-AUDIO/TONE)

D C/W TONE BOOSTER ASSEMBLY

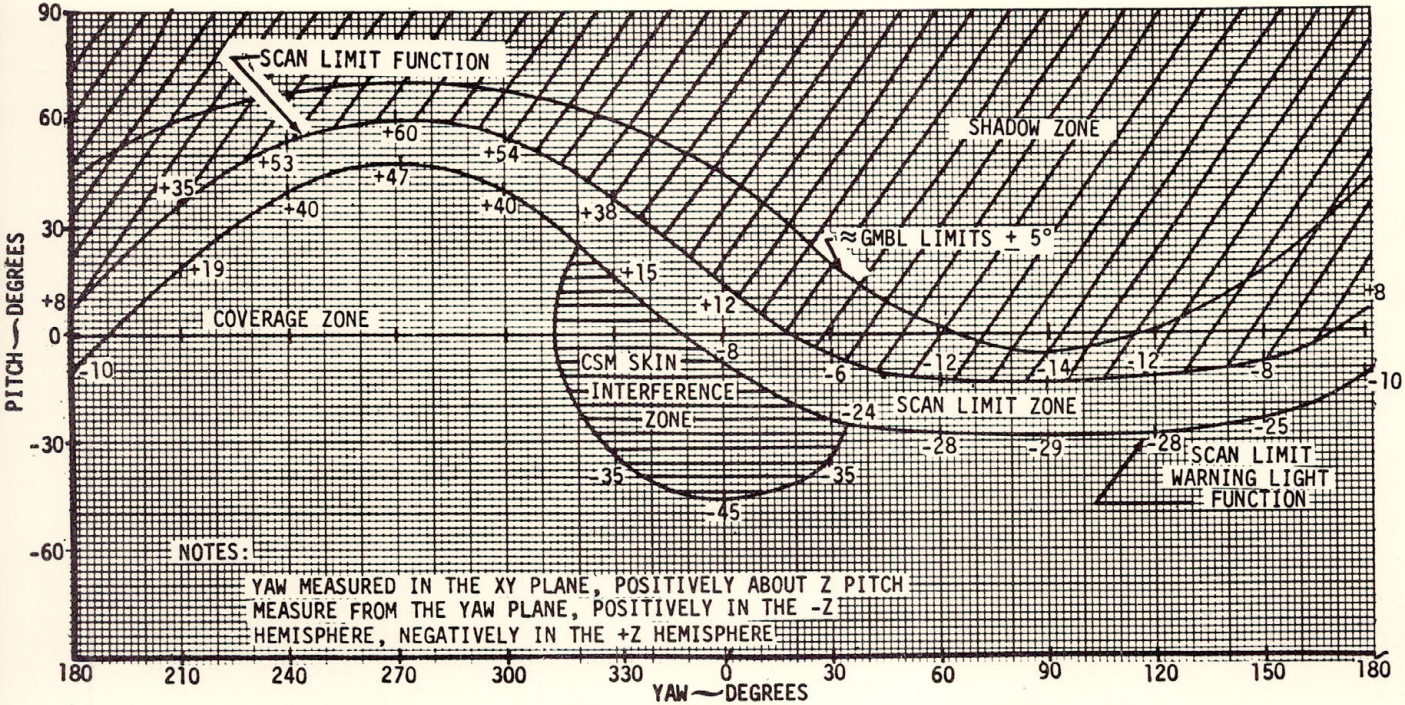
a. Installation
UTIL PWR - OFF
Install connector
Position sensor over MA lt
UTIL PWR - on (up)
Install beeper on L.H. (R.H.) girth shelf

b. Operational Check
C/W LAMP TEST - 1(2) (hold)





Basic Date October 6, 1969
Changed
CSM 108



HIGH GAIN LIMIT GRAPH

F
10-18

HIGH-GAIN ANTENNA SCAN AND WARNING LIMIT,
YAW-PITCH COORDINATES (CSM)

TELECOMM PROCEDURES

1 HI-GAIN ANTENNA OPERATION

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

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

HI-GAIN ANT PITCH & YAW POS (2) - Set in required coordinates
If in earth orbit, S-BD NORM PWR AMPL HI-off(ctr)
S BD ANT - HI GAIN
HI-GAIN ANT S BD ANT ind - >1/2 scale
HI-GAIN ANT TRACK - AUTO or REACQ
HI-GAIN ANT BEAM - as required depending on range
HI-GAIN ANT S BD ANT ind - >1/2 scale
When omni antenna operation is desired:
HI-GAIN ANT TRACK - MAN
HI-GAIN ANT PITCH POS - -52°
HI-GAIN ANT YAW POS - 270°

2 TV CAMERA OPERATION (COLOR)

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

3 VHF RANGING OPERATION

VHF AM A - off (ctr)
VHF AM B - DUPLEX
VHF RNG - on (up)
P20 operating
V87E, TRACKER 1t - on
EMS FUNC - ΔV SET/VHF RNG
EMS MODE - BACKUP/VHF RNG

Basic Date October 6, 1969
Changed
CSM

CAUTION
No VHF voice transmission for
≈ 12 sec after VHF RNG - RESET

VHF RNG - RESET
EMS RANGE ind - 000 00
P20 operating, TRACKER lt - out
EMS RANGE ind - XXX XX
V83E (if desired)
R1 = RANGE
R2 = RANGE RATE
R3 = Θ
V85E (if desired)
R1 = RANGE
R2 = RANGE RATE
R3 = Ø

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

5 COMM MODES
NORMAL LUNAR CONFIGURATION
S BD XPNDR - PRIM
S BD PWR AMPL - PRIM
S BD PWR AMPL HI - HI
S BD MODE VOICE - VOICE
S BD MODE PCM - PCM
S BD RNG - RNG

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

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

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

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

Basic Date October 6, 1969
Changed
CSM 108

C. LUNAR ORBIT AWAKE
USE NORMAL LUNAR CONFIGURATION

D. LUNAR ORBIT ASLEEP
S BD SQUELCH - ENABLE
HI GAIN ANT TRACK - REACQ
HI GAIN ANT BEAM - NARROW
HI GAIN ANT P,Y, = _____, _____

E. VHF RANGING, VOICE
VHF AM B - DUPLEX
VHF RNG - on (up)
VHF RCV ONLY - B DATA (MINIMIZES CREW SWITCHING)

F. VHF LM-CSM VOICE DATA
VHF AM A - SIMPLEX
VHF RCV ONLY - B DATA

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

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

Basic Date October 6, 1969
Changed
CSM 108

Voice Relay (With LM LBR PCM record)

MODE - VOX (Pnl 10)
VOX SENS tw - 5
S BD - OFF
INTERCOM - OFF
VHF AM - T/R
AUDIO CONT - BU
MODE - VOX (Pnl 9)
VOX SENS tw - as req
S BD MODE VOICE - RELAY
VHF AM A - SIMPLEX
VHF RCV ONLY - B DATA

I. LUNAR STAY

VHF AM B - DUPLEX
VHF AM - RCV (Pnl 9)
HI GAIN ANT BEAM - NARROW
HI GAIN ANT TRACK - REACQ
HI GAIN ANT P_____, Y_____
S BD SQUELCH - ENABLE

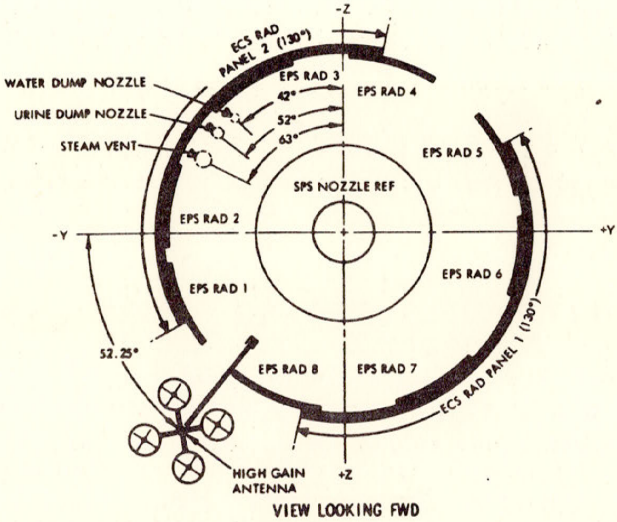
PRESLEEP CHECKLIST

CREW STATUS REPORT (MEDICATION)
ONBOARD READOUTS
CYCLE O2 & H2 FANS
CHLORINATE POTABLE WATER
VERIFY:
WASTE MNGMT OVBD DRAIN - OFF
WASTE STOW VENT vlv - CLOSED
EMERGENCY CABIN PRESS - BOTH
SURGE TANK O2 vlv - ON
REPRESS PKG O2 vlv - OFF
LM TUNNEL VENT vlv - LM/CM ΔP
"E" MEMORY DUMP
CONFIGURE COMMUNICATIONS (F/10-22)

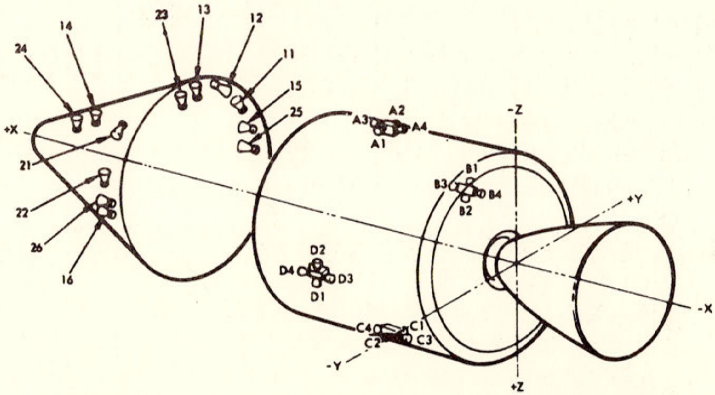
POST SLEEP CHECKLIST

CREW STATUS REPORT (SLEEP & RADIATION)
CONSUMABLES UPDATE
CYCLE O2 & H2 FANS
CONFIGURE COMMUNICATIONS (F/10-22)

Basic Date October 6, 1969
Changed
CSM 008



VIEW LOOKING FWD



CM RCS CODE

FIRST DIGIT: SYSTEM (1 OR 2)
SECOND DIGIT: 1, 2 (+, -ROLL) 3, 4 (+, -PITCH) 5, 6 (+, -YAW)

SM RCS CODE

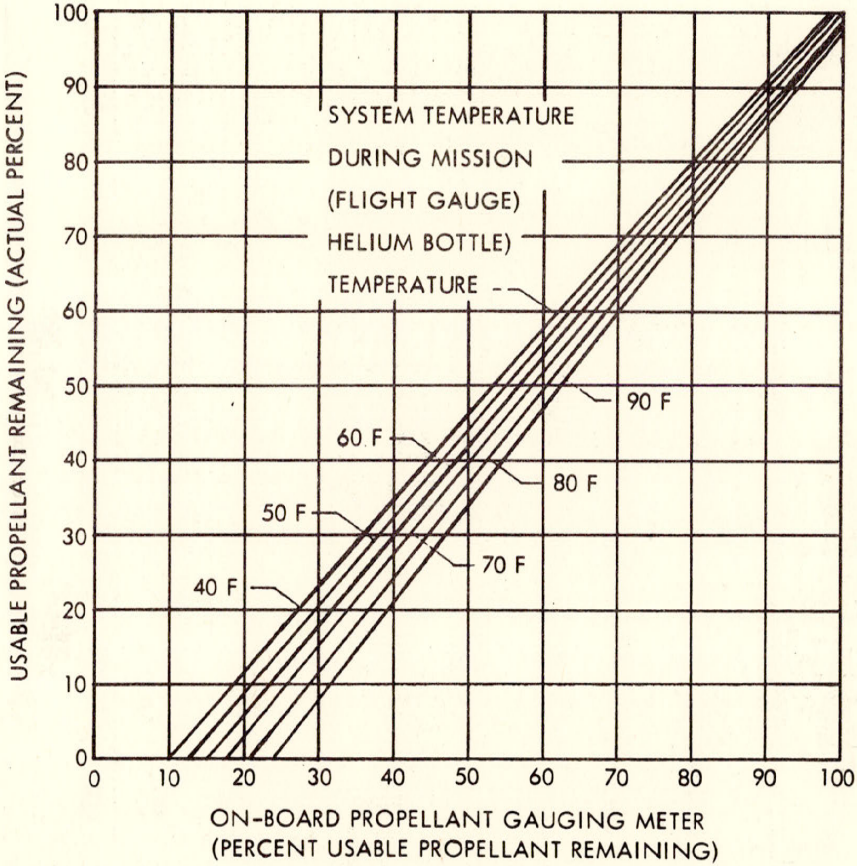
1 AND 2 ARE ROLL ENGINES
3 AND 4 ARE A/C PITCH OR B/D YAW ENGINES
1 AND 3 = + ROTATION, 2 AND 4 = - ROTATION

RCS Engines, Vent, and Radiator Location

Basic Date October 6, 1969
Changed
CSM 108

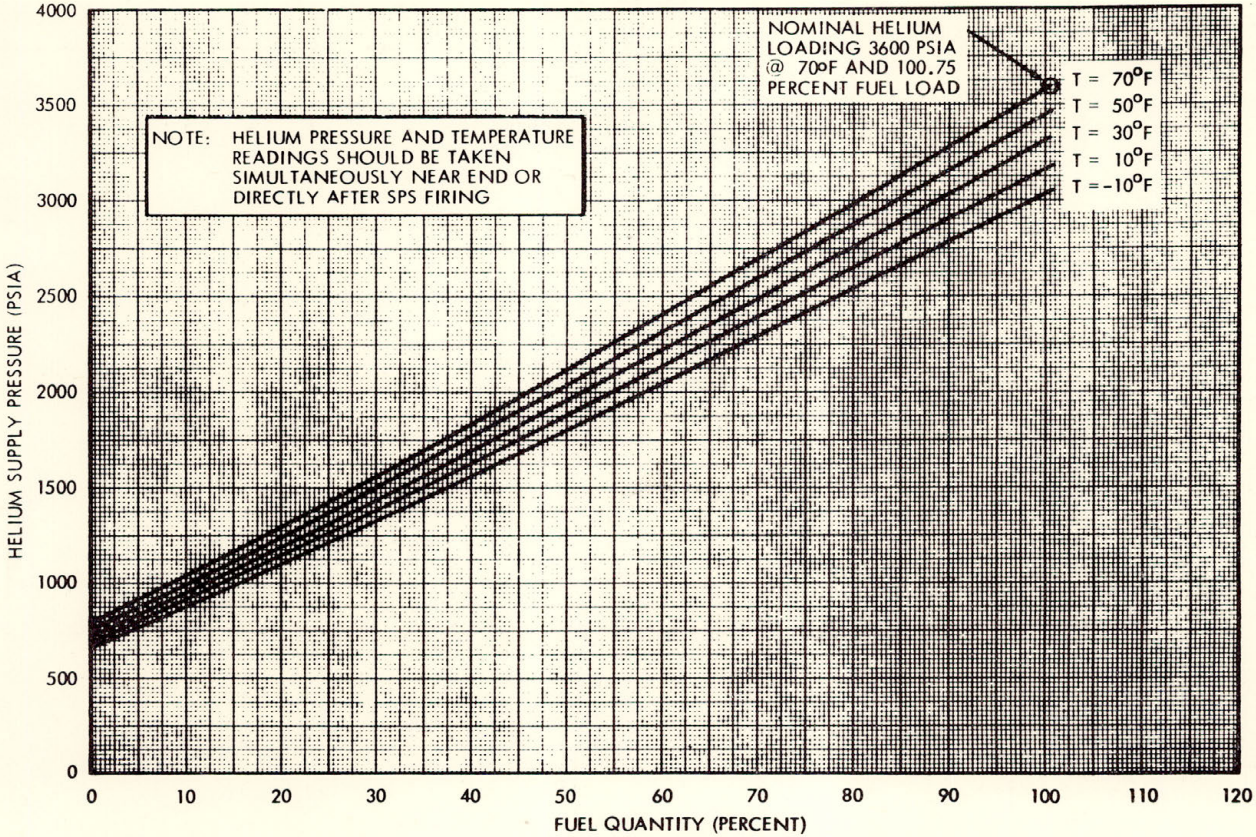
SYSTEMS TEST Indicator Display	N2, O2, H2 Pressure (psia)	EPS Radiator Outlet Temperature (°F)	CM-RCS Oxidizer Valve Temperature (°F)	LM Power (amps)	SPS Temperature (°F)	Battery Compartment Manifold Pressure (psia)	Battery Relay Bus (vdc)
0.0	0	-50	-50	0	0	0.00	0
0.2	3	-36	-46	0.4	8	0.80	1.8
0.4	6	-22	-42	0.8	16	1.60	3.6
0.6	9	-8	-38	1.2	24	2.40	5.4
0.8	12	+6	-34	1.6	32	3.20	7.2
1.0	15	+20	-30	2.0	40	4.00	9.0
1.2	18	+34	-26	2.4	48	4.80	10.8
1.4	21	+48	-22	2.8	56	5.60	12.6
1.6	24	+62	-18	3.2	64	6.40	14.4
1.8	27	+76	-14	3.6	72	7.20	16.2
2.0	30	+90	-10	4.0	80	8.00	18.0
2.2	33	+104	-6	4.4	88	8.80	19.8
2.4	36	+118	-4	4.8	96	9.60	21.6
2.6	39	+132	0	5.2	104	10.40	23.4
2.8	42	+146	+4	5.6	112	11.20	25.2
3.0	45	+160	+10	6.0	120	12.00	27.0
3.2	48	+174	+14	6.4	128	12.80	28.8
3.4	51	+188	+18	6.8	136	13.60	30.6
3.6	54	+202	+22	7.2	144	14.40	32.4
3.8	57	+216	+26	7.6	152	15.20	34.2
4.0	60	+230	+30	8.0	160	16.00	36.0
4.2	63	+244	+34	8.4	168	16.80	37.8
4.4	66	+258	+38	8.8	176	17.60	39.6
4.6	69	+272	+42	9.2	184	18.40	41.4
4.8	72	+286	+46	9.6	192	19.20	43.2
5.0	75	+300	+50	10.0	200	20.00	45.0

Systems Test Indicator Conversion Chart



Minus Two-Sigma Service Module RCS
On-Board Propellant Gauging Meter
Correction Nomograph

SPS PROPELLANT NOMOGRAPH



LM INTERFACE

1 IVT TO LM (CHECKOUT, TLC)

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

Remove hatch & stow (Decal) (3)
Remove probe & stow (Decal) (4)
Remove drogue & stow (Decal) (5)
Read docking tunnel index angle _____
Open LM hatch
Transfer the following to LM:

Box of kleenex	A1
2 towels	A1
16mm magazines in bag (6)	R13
70mm magazines in bag (3)	R13
70mm magazines HCEX (2)	R13

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

2 IVT TO LM (UNDOCKING, DOI)

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

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

CDR transfer to LM (6)
LMP transfer to CSM (6A)
LMP don LCG & PGA
LMP transfer to LM (6)
Remove LM umbilicals (7)
Install drogue (Decal) (8)
Install probe (Decal) (9)
Preload probe (Decal) (10)
LM hatch closed
Verify CSM roll cmds inhibited
until LM/CM ΔP ≥3.5 psid (>3.5,2 jet; >4,4 jet)
Cock docking latches (Decal) (13)

Install tunnel hatch (Decal) (11)
Perform hatch integrity check (Decal) (12)
Remove center couch and stow
Install docking target

DOCKING TARGET - BRIGHT
Receive target alignment verification from LM
Configure side hatch for EVT
ACTR HANDLE SEL - N (neutral)
GN2 VLV HANDLE - pull (inboard)
GN2 PRESS ind - minimum

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

4 PROBE REMOVAL (CM Side) (Decal)
NOTE: Probe may be hot from stay in Lunar orbit
A. Translunar Docking:
Verify EXTEND LATCH engaged indicator (red) not visible

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

GN2 BLEED button (RED) - press (10 sec)
PRELOAD SEL LEVER - rotate CCW (parallel to orange stripe)
PRELOAD HNDL - Torque (CW) unload support beams
B. Lunar Orbit Docking:
PRELOAD SEL LEVER - rotate CW(away from orange stripe)
PRELOAD HNDL - torque CCW to engage EXTEND LATCH (red indicator not visible)
GN2 BLEED button (red) - press (10 sec)
C. Both TLD & LOD:
PROBE UMBILICALS (2) (yellow) - disconnect and stow
Elec connector covers (2) (yellow) - close
PRELOAD HNDL - position against umbilical connector

Basic Date October 6, 1969
Changed
CSM 108

PRELOAD SEL LEVER - mid position
INSTALLATION STRUT - unstow, position on tunnel wall (yellow marks)
CAPTURE LATCH RLSE HNDL LOCK - Rotate CCW to unlock (orange stripe visible)
RATCHET HNDL - unstow to full extension
- push to first detent (red band)
- push outbd and hold to fold probe
RATCHET HNDL - pull to full extension
- ratchet one stroke only
Restow RATCHET HNDL and INSTALLATION STRUT
CAPTURE LATCH RLSE HNDL - Pull, rotate to unlock (180° CW)
- push to recess

*Capture latches will not release: *
* Ratchet probe forward *
* Preload probe until latches release*

Remove PROBE - pull aft to release (25 lbs)

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

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

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

Basic Date October 6, 1969
Changed
C 108

```
*Cannot vent tunnel:                          *
*  If O2 FLOW ind. increases, open hatch,*
*    wipe seal surfaces, close hatch          *
*  If O2 FLOW ind does not increase, dump*
*    tunnel through LM during reg check  *
*  Monitor LM/CM ΔP & flow to check          *
*    integrity                                *
```

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

Verify O2 FLOW ind - no increase

Before Undocking only:

TUNL VENT vlv - LM TUNL VENT for 10 min, then LM/CM ΔP

Verify LM/CM ΔP >4.0(pegged)

TUNL VENT vlv - OFF

TUNNEL LIGHTS - OFF

Before Jettison only:

TUNL VENT vlv - TUNL VENT (at least 10 min)

TUNNEL LIGHTS - OFF

13 DOCKING LATCH RELEASE (Decal) (I) (J)

Release Button - depress

Latch Hndl - pull one or two strokes until bungee recocks

Verify latch hook rotated inboard to clear LM ring

```
* Hook does not release  *
*   AUX RES(yellow)-push *
*   cock latch           *
```

Verify/push latch hndl outboard against latch hook

14 SOFT UNDOCKING

PROBE EXTD/REL-EXTD/REL (momentarily)

Verify probe is extended and LM attached

Allow motion to damp (5 sec)

PROBE EXTD/REL-EXTD/REL and hold (<20sec)

After 2 sec:

Thrust -X (4 jet) for 1 sec

After probe/drogue disengaged:

PROBE EXTD/REL-OFF

Basic Date October 6, 1969
Changed
CSM 108

MALFUNCTION LIST

DOCKING

A. Positive Indication of No Capture
THC -X withdraw to formation
flight distance
- PROBE EXTD/REL - EXTD/REL for 5 sec
- RETR
- PROBE EXTD/REL tb(2) - gray (verify)
- Attempt redocking as before

B. One tb does not indicate bp but capture attained
(refer to malfunction procedures)

TUNNEL HATCH

C. Pressure Equalization Valve Will
Not Close
- Remove Hatch
- Use Tool B In External Tool Interface For Additional Leverage

D. Pressure Equalization Valve Will
Not Open For TLD:
- Vent CM
- Perform Tunnel Operations
- Repress CM

For Subsequent IVT
TUNL VENT vlv - LM PRESS
(May require up to 12 hrs
to equalize pressure)

PROBE

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

Basic Date October 6, 1969
Changed
CSD 108

F. (deleted)

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

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

DOCKING LATCHES

I. Cannot Cock Docking Latch By Pulling Handle
- Depress Aft End Of RH No-Back Pawl While Pulling On Latch Handle.
- If unsuccessful, Use Tools E&R to depress LH No-Back Pawl while pulling on Latch Handle

TUNNEL

J. High O2 Flow While Cocking Docking Latches
- Re-engage/verify 3 latches ∿120° apart are engaged
- Slowly torque PRELOAD HNDL (CW) until breakout releases; repeat (3) times
- Disengage docking latches

Basic Date October 6, 1969
Changed October 27, 1969
CSM 108

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).

2 POO, V49, Load LM jett attitude:
F 06 22: R 219, P 358, Y 342
SC CONT - CMC
CMC MODE - AUTO
BMAG MODE (3) - RATE 2
PRO
PRO (Auto mnvr to jett att)

CDR transfer to CM
CM Jettison articles to LM
WARNING
No Urine/Feces
All opened food must be treated
and stored in Beta bag

LMP Close LM hatch
Transfer to CSM
CMP DIRECT 02 vlv - close (CW)
Unstow & install forward hatch(DECAL)(11)
Perform hatch integrity check(DECAL) (12)

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

3 At Jett Attitude:
ENTR
EMS FUNCT - ΔV SET/VHF RNG
EMS ΔV ctr - +100 fps
EMS FUNCT - ΔV
BMAG MODE (3) - ATT 1/RATE 2
ATT BD - MIN
RATE - LOW
SC CONT - SCS
Load DAP N46:
R1= 11102, R2= 01111
(-01:00m) V37E 47E
EMS MODE - NORMAL

Basic Date October 6, 1969
Changed ~~October 27, 1969~~ November 7, 1969
CSM 108

4 CSM/LM FINAL SEP (2) - ON (.4 fps sep)
SECS PYRO ARM (2) - SAFE
SECS LOGIC (2) - OFF
cb SECS ARM (2) - open
SC CONT - CMC
BMAG MODE (3) - RATE 2
MNVR (180°, 90° ORDEAL, 0°)

5 SEP (2 jet +Z 1.0 fps)
PRO (POO)

6 EMS MODE - STBY
EMS FUNCT - OFF
SC CONT - SCS
MAN ATT (3) - MIN IMP
Track LM
P20, V77 at 1 mile

7 VACUUM & DOFF PGA'S
SUIT RET vlv - closed
DEMAND REG - OFF
ALL SUIT FLOW vlv - FULL FLOW
Install interconnect on
LH O2 red hose
Install vacuum brush on RH
O2 red hose
Install screen on CO2 red hose
Vacuum brush PGA (2)
SUIT RET vlv - open
DEMAND REG - BOTH
Empty PGA (2) pockets
Doff PGA (2)
Move watch (2) from PGA to arm
Stow PGA (2)

8 All wash hands thoroughly

CONTINGENCY EVA

CM PREP FOR CONTINGENCY EVA

1 C and R SUIT FLOW - OFF
2 L SUIT FLOW - CAB FLOW
3 EVA Stabilizer Strut Installed
4 C and R 02 hoses interconnected with A-1 interconnects
5 C hoses routed through handhold under Panel 10 for EVT
6 R hoses secured around RH Couch headrest for EVT
7 TSB's installed on R&L girth ring & LEB
8 Seat, leg, and foot pans folded against back pan with seat pan locked
9 PGA bag disconnected from center couch
10 Couch straps unstowed
11 Center couch removed and stowed under LH couch
12 L and R couch - 270°
13 Marmon clamps closed and locked
14 Disconnect and tie off LH X-X Strut
15 PGA bag secured to aft bulkhead
16 Jack screws (A1) fully opened and taped near hatch
17 Tool Kit (A1) Snapped to R.H. girth ring
18 Hatch counterbalance piston chamber vented
19 Counter balance disengaged (Pull pip pin, stow in [redacted] A-1)
20 MDC INGRESS BAR STOWED
21 CABIN FAN (Both) - OFF
22 REPRESS PKG vlv - FILL

CREW STATUS

UCTA Donned and empty
Helmet stowed in helmet bag
Comm carrier donned
Gloves stowed
L 02 PGA LOCK - LOCK
L elec umb connected to PGA
SUIT FLOW vlv - CAB FLOW
SUIT CKT RET vlv - open (pull)
EMER CAB PRESS sel - BOTH
Chronometer on left PGA sleeve
Verify PGA zipper lock - lock

Basic Date October 6, 1969
Changed November 7, 1969

SYSTEM PREPARATION FOR DEPRESS

Verify REPRESS O2 press 865-935 psi
EMERG O2 vlv - closed
Verify REPRESS O2 vlv - closed
Verify surge tank vlv - on
O2 PRESS IND sw - SURGE TK
Verify surge tank pressure 865-935 psi
Select attitude control mode and maneuver spacecraft
  to EVT attitude (TBD)
AUTO RCS SELECT - undocked transfer
  A/C ROLL - A1,A2 - OFF
  PITCH - A3 - OFF
  YAW - B3 - OFF
AUTO RCS SELECT - Docked transfer
  A11 - OFF
Check status of LM prep for egress

Stow loose items
  NOTE: Perform PLSS Comm check if required
    On request by LM,
      VHF A - Duplex
      VHF B - OFF (verify)
      VHF RANGING - OFF (verify)
    Verify Comm with,
      2 PLSS - CDR (EVCS #1) and then
        LMP (EVCS #2)
      or
      1 PLSS - EVCS #1 or #2

FINAL SYSTEMS PREP FOR DEPRESS

Verify surge tank pressure 865-935 psi
EXT LTS - RUN/EVA - on (up) (IF REQ'D)
EXT LTS - RNDZ/SPOT - off (ctr)

PREP FOR CABIN DEPRESS

Verify L O2 hoses connected Red/Red, Blue/Blue
Verify PGA flow diverter valve horizontal
Unstow helmet
Verify feed port cover installed and locked, wipe
  helmet with anti-fog
Verify PGA comm lead inside PGA and
  clear of suit neck ring

Place helmet attaching neck ring in
the "ENGAGE" position
Position mike, don helmet (with shield) and lock
Secure helmet stowage bag
Place suit wrist disconnects to "ENGAGE" position
Don gloves and lock
SUIT RET vlv - close (push)
EMERG CAB PRESS sel - off
Check all PGA connections and
verify locked.
Ingress LH couch

PRESS INTEGRITY CHECK (DECAL)

1 DIRECT 02 - CLOSE (CW)
2 SUIT PRESS ind - 4.7-5.3 psia
3 02 FLOW ind - 0.2-0.4 LB/HR
4 SUIT TEST vlv - PRESS (DIR 02 - OPEN
At 4.0 psig, DIR 02 - OFF)
5 02 FLOW ind - 1.0 LB/HR (pegged)
6 02 FLOW HI LT - ON
7 MASTER ALARM PB/LT (3) - ON (PUSH)
8 CYCLE SUIT CKT RET AIR vlv OPEN and
CLOSE At SUIT PRESS of 1.5-2.0 psig
9 SUIT PRESS ind -8.8-9.8 psia
10 PGA PRESS ind - 4.1-4.5 psig
11 02 FLOW HI LT - OUT
12 Allow 02 FLOW To Stabilize 15 sec
13 02 FLOW Shall Remain Below 0.8 LB/HR
For 30 sec After Stabilization
14 SUIT TEST vlv - DEPRESS
15 02 FLOW ind - 0.2-0.4 LB/HR
16 SUIT PRESS ind - Slight > CABIN
PRESS ind
17 SUIT TEST vlv - OFF
18 Verify DEMAND REG SEL - BOTH

CABIN DEPRESS

Egress LH couch and transfer to hatch
Adjust RH strut mirror to read cabin pressure

CABIN DEPRESS (DECAL)

1 CABIN FAN (2) - OFF
2 REPRESS PKG 02 vlv - FILL
3 REPRESS 02 vlv - CLOSE (verf)
4 CAB PRESS REL vlv (2) - NORMAL
5 SIDE HATCH DUMP vlv - OPEN
(02) FLOW HI WARNING LT May Come On
Prior To CABIN PRESS REG LOCK UP)
6 At 3.25 psia, SIDE HATCH DUMP vlv - CLOSE
7 02 FLOW ind - LESS THEN 0.5 LB/HR
8 CABIN PRESS 3.25 psia
9 SUIT CKT PRESS STABLE 3.5 - 4.0
10 SIDE HATCH DUMP vlv - OPEN
11 CABIN PRESS ind - 0

HATCH OPENING (DECAL)

1 GN2 vlv HANDLE - PULL
2 GAGE READS - MIN
3 LOCK PIN RELEASE KNOB - UNLOCK
4 LOCK PIN INDICATOR RELEASED
5 GEAR BOX SEL - UNLATCH
6 ACTR HANDLE SEL-U
7 UNSTOW ACTR HANDLE
8 UNLOCK HATCH
9 ACTR HANDLE SEL-L
10 STOW ACTR HANDLE
11 GEAR BOX SEL-LATCH
12 OPEN HATCH
13 START ELAPSE TIME WHEN OPS ACTIVATED

EVT (DOCKED)
Give GO for TRANSFER TO OPS & EVT
Start elapse time when OPS activated

EVT (UNDOCKED, STABLE)
Maneuver CSM APEX to LM forward hatch
Give GO for transfer to OPS & EVT
Start elapse time when OPS activated

EVT (UNDOCKED, UNSTABLE)
Maneuver CSM to LM
Give GO for transfer to OPS & EVT
Start elapse time when OPS activated
After CDR & LMP push away from LM, maneuver
    APEX to CDR and LMP

INGRESS (2 OPS)
CDR Ingress CM, feet first, face away from MDC
    and move to LEB
    Retrieve C 02 hoses and ELEC UMB
CMP Connect C electrical umbilical to CDR
CDR Audio panel sws - as desired
    Secure position in LEB and manage
    lifeline for LMP
LMP Ingress CM, feet first, face away from MDC
    and assume position for closing side hatch

INGRESS (CDR - OPS, LMP - PLSS or 2 PLSS/OPS), pg F/12-10
    PLSS Feedwater vlv - CLOSE

VAC TRANSFER TO CM ECS
  (If 25 minutes elapsed from
  OPS start time, perform the following)

CDR Verify C and R SUIT FLOW vlv - OFF

[If PLSS/OPS:
Disconnect PURGE vlv, then OPS Hose]

Remove interconnect and hand C O2 hoses to CMP

CMP Connect C O2 hoses to CDR PGA (RED/RED, BLUE/BLUE)

CDR Close purge valve
C SUIT FLOW vlv - adjust for comfort
OPS O2 shutoff vlv - close

[If PLSS:
PLSS O2 vlv - close
PLSS Fan - OFF]

LMP Verify R SUIT FLOW vlv - OFF
Remove interconnect and hand R O2 hoses to CDR

CDR Connect R O2 hoses to LMP PGA (RED/RED, BLUE/BLUE)
Close purge valve
SUIT FLOW vlv (3) - FULL FLOW
Verify flow and close OPS O2 shutoff valve
Connect R electrical umbilical
Audio panel sws - as desired

HATCH CLOSING (DECAL)

1 CLOSE HATCH
2 LOCK HATCH
3 Verify LOCK PIN Dropped in
4 STOW ACTR HANDLE
5 ACTR HANDLE SELECT-N
6 GEAR BOX SEL-LATCH (verify)

CABIN REPRESS (DECAL)

1 SIDE HATCH DUMP vlv - CLOSE
2 REPRESS O2 vlv - OPEN (10 sec)
Then CLOSE
3 CABIN PRESS Approx - 1.0 PSIA
4 CABIN PRESS ind - Monitor for
Gross Leakage (30 sec)
5 REPRESS O2 vlv - OPEN

6 Control Surge Tank Press >150 psia
7 REPRESS PKG VLV - OFF
8 CABIN PRESS ind - 3.0 psia
9 REPRESS O2 vlv - CLOSE
10 Dump OPS into cabin (if avail)
11 CABIN REPRESS vlv - OPEN (CW)
12 Maintain surge tank press >150 psia

B Remove LEVA'S From Helmets
CDR Verify cabin pressure above 3.0 psia
Verify C and R SUIT FLOW vlv - OFF
Remove interconnect from C O2 hoses
CDR OPS O2 shutoff vlv - close
As PGA press equalizes with cabin
Connect hoses to PGA (red to red, blue to blue)
No flow condition, remove helmet at safe cabin press
C SUIT FLOW vlv - adjust for comfort
L SUIT FLOW vlv - increase for comfort
Close purge valve
Remove interconnect from R O2 hoses
LMP OPS O2 shutoff vlv - close
As PGA press equalizes with cabin
Connect hoses to PGA connectors (red to red, blue to blue)
No flow condition, remove helmet at safe cabin press
CDR SUIT FLOW vlv (3) - FULL FLOW
LMP Close purge valve
Verify SUIT PWR - OFF
Verify PWR sw - OFF
Verify AUDIO CONT - NORM
Connect R electrical umbilical to PGA
AUDIO PANEL sws - as desired
NOTE - If CDR and LMP desire to doff OPS at this point, refer to doffing procedures. CMP continue monitoring cabin repress

POST EVA SYSTEMS CONFIGURATION

CMP CAB PRESS ind - 4.7-5.3 psia
    O2 PRESS IND sw - TK 1
CDR CAB REPRESS vlv - OFF (CCW)
    Doff gloves, helmets, and LEVA's, if req'd
    If helmets and gloves doffed:
        EMERG CAB PRESS sel - BOTH
        SUIT RET vlv - open (pull)

OPS DOFFING

Remove waist tethers, lifeline, and stow in TSB
Remove purge valves and stow in TSB
Verify PLSS antenna stowed
Verify OPS O2 shutoff vlv - close
Verify OPS O2 actuator stowed
Disconnect OPS O2 hose and stow
Secure thermal cover
Doff OPS and PLSS straps
Secure OPS with PLSS straps
Stow interconnects in A-1
Secure transfer TSB

FINAL SYSTEM CONFIGURATION

O2 PRESS IND sw - SURGE TK
CRYO O2 PRESS 1 ind - 500 psia
Verify CAB REPRESS vlv - OFF (CCW)
Verify REPRESS O2 - CLOSE
REPRESS PKG VLV - FILL
Verify repress O2 press increasing
CRYO O2 PRESS 1 ind - 865-935 psia
O2 PRESS IND sw - TK 1
REPRESS PKG VLV - OFF

POST EVA CABIN CONFIGURATION

Remove CSRC from PGA pocket and stow in A-5
EXT LTS - RUN/EVA - OFF (down)
Perform as desired
  (a) change crew stations
  (b) Restow tool B & jack screws
  (c) Unstow & install PGA bag
  (d) Reinstall center couch
  (e) Connect counterbalance (Pip pin in ~~R-10~~ A-1)

EVT EQUIPMENT STOWAGE FOR ENTRY

I. CM reentry without suits:

ITEM	STOWAGE LOCATION FOR REENTRY
a. OPS (2)	In PGA
b. Purge Valve (2)	In PGA
c. Life Line	In PGA Bag
d. EV Gloves	On PGA
e. LEVA (2)	2 on Helmet attached to Suits in RH & LH sleep restraints
f. Waist tether (2)	In PGA Bag
g. CSRC	Vol A5
h. HSB/Samples	In PGA bag toward LEB
i. Suits	1 Suit with OPS's in PGA Bag w/tie down rope. 2 Suits in Sleep Restraint under LH & RH Couch w/tie down rope.
j. Helmets	2 On suits with LEVA 1 in B1

II. CM reentry with suits:

ITEM	STOWAGE LOCATION FOR REENTRY
a. OPS (2)	LH & RH Sleep Restraint in PGA Bag w/tie down rope.
b. HSB/Samples	In sleep restraint with OPS's

Basic Date October 6, 1969
Changed
CSM 108

c. Purge Valve (2)	LH & RH Sleep Restraint in PGA Bag w/tie down rope.
d. Life Line	In PGA Bag
e. EV Gloves	On PGA
f. LEVA (2)	1 in Vol B1, 1 in Vol L3.
g. Waist Tether (2)	In PGA Bag
h. CSRC	Vol A5

III. The following equipment may be transferred in PGA pockets during the EV transfer:

ITEM	STOWAGE LOCATION
a. Film Magazines	Vol R13
b. Log Books	Vol R1, R2 and R3

INGRESS (CDR-OPS, LMP-PLSS or 2 PLSS/OPS)

CDR Ingress CM, feet first, face away from MDC
and move to LEB
Retrieve C 02 Hoses and Elec Umb
CMP Connect C electrical umbilical to CDR (WITH PLSS/OPS
DISCONNECT PLSS COMM IF REQ'D-PLSS MODE SEL-POS 0)
CDR Audio panel sws - as desired
Secure Position in LEB and Manage Lifeline for LMP
LMP Ingress CM, feet first, face down,
and assume position for closing side hatch

VAC TRANSFER TO CM ECS

(If 25 Minutes Elapsed from OPS Start Time,
Perform the following)

October 6, 1969
Basic Date
Changed
CSM 108

CDR Verify C and R SUIT FLOW vlv - OFF
Remove interconnect and hand C 02 hoses to CMP
CMP Connect C 02 hoses to CDR PGA (red to red, blue to blue) (WITH PLSS/OPS-REMOVE OPS PURGE VLV AND 02 HOSE
CDR Close purge valve
C SUIT FLOW vlv - adjust for comfort
OPS 02 shutoff vlv - close (WITH PLSS/OPS-PLSS 02 vlv- CLOSE - PLSS FAN - OFF)
LMP Verify R SUIT FLOW vlv - OFF
Remove interconnect and hand R 02 hoses to CDR
CDR Remove LMPS OPS purge vlv and 02 hose if connected
CDR Connect R 02 hoses to LMP PGA (red to red, blue to blue)
LMP Close purge valve
CDR SUIT FLOW vlv (3) - FULL FLOW
LMP Verify flow
PLSS 02 vlv - CLOSE
PLSS FAN - OFF
Connect R electrical umbilical (WITH PLSS/OPS-DISCONNECT PLSS COMM IF REQ'D - PLSS MODE SEL - POS 0)
Audio panel sws - as desired
PLSS Feedwater vlv - CLOSE

HATCH CLOSING (DECAL)

1 CLOSE HATCH
2 LOCK HATCH
3 Verify LOCK PIN Dropped in
4 STOW ACTR HANDLE
5 ACTR HANDLE SELECT-N
6 GEAR BOX SEL - LATCH (verify)

CABIN REPRESS (DECAL)

1 SIDE HATCH DUMP vlv - CLOSE
2 REPRESS 02 vlv - OPEN (10 sec)
Then CLOSE
3 CABIN PRESS approx - 1.0 psia
4 CABIN PRESS ind - monitor for gross leakage (30 sec)
5 REPRESS 02 vlv - OPEN
6 Control Surge Tank PRESS >150 psia
7 REPRESS PKG vlv - OFF

8 CABIN PRESS ind - 3.0 psia
9 REPRESS 02 vlv - CLOSE
10 Dump OPS into Cabin (if avail)
11 CABIN REPRESS vlv - OPEN (CW)
12 Maintain Surge Tank Press >150 psia

Remove LEVA's from helmets
Verify cabin pressure above 3.0 psia
Verify C and R SUIT FLOW vlv - OFF
Remove interconnect from C 02 hoses
CDR OPS 02 shutoff vlv - close(WITH PLSS/OPS-PLSS 02 VLV - CLOSE)
(OPEN PURGE VLV IF ATTACH TO EQUALIZE PRESS)
As PGA press equalizes with cabin
Connect hoses to PGA (red to red, blue to blue)
No flow condition, remove helmet at safe cabin press
(WITH PLSS/OPS - REMOVE OPS 02 AND PURGE VLV)
C SUIT FLOW vlv - adjust for comfort
L SUIT FLOW vlv - increase for comfort
Close purge valve (WITH PLSS/OPS - PLSS FAN-OFF)
Remove interconnect from R 02 hoses
LMP PLSS 02 vlv-CLOSE
(OPEN PURGE VLV IF ATTACH TO EQUALIZE PRESS)
As PGA press equalizes with cabin,
Connect hoses to PGA connectors (WITH PLSS/OPS-REMOVE OPS 02 HOSE AND PURGE VLV)
(red to red, blue to blue)
For no flow condition, avoid negative press, remove helmet at safe cabin press
CDR SUIT FLOW vlv (3) - FULL FLOW
LMP Close purge valve if attach
PLSS FAN - OFF
Verify SUIT PWR - OFF
Verify PWR sw - OFF
Verify AUDIO CONT - NORM
Connect R electrical umbilical to PGA
(WITH PLSS/OPS-DISCONNECT PLSS COMM-
PLSS MODE SEL - POS 0)
AUDIO PANEL sws - as desired
NOTE - If CDR and LMP desire to doff PLSS/OPS at this point, refer to doffing procedures. CMP continue monitoring cabin repress

POST EVA SYSTEMS CONFIGURATION

CMP CAB PRESS ind - 4.7-5.3 psia
    02 PRESS IND sw - TK 1
CDR CAB REPRESS vlv - OFF (CCW)
    Doff gloves, helmets, and LEVA's, if req'd
    If helmets and gloves doffed - EMERG CAB PRESS
      SEL - BOTH
      SUIT RET VLV - OPEN (PULL)

OPS DOFFING

Remove waist tethers, lifeline, and stow in TSB
Remove purge valves and stow in TSB
Verify PLSS antenna stowed
Verify OPS 02 shutoff vlv - close
Verify OPS 02 actuator stowed
Disconnect OPS 02 hose and stow
Secure thermal cover
Doff OPS and PLSS straps
Secure OPS with PLSS straps
Stow interconnects in A-1
Secure transfer TSB

PLSS/OPS DOFFING

Remove waist tethers, lifeline, and stow in TSB
All RCU ELEC CNTLS-OFF
Disconnect RCU stow in TSB
Disconnect PLSS 02 and H20 Hoses
Disconnect Lower then Upper PLSS straps-DOFF-PLSS
Stow PLSS-02,H20,and COMM Umbilicals
Stow OPS-02 Actuator and 02 hose
Temp stow PLSS/OPS

FINAL SYSTEM CONFIGURATION

02 PRESS IND sw - SURGE TK
CRYO 02 PRESS 1 ind - 500 psia
Verify CAB REPRESS vlv - OFF (CCW)
Verify REPRESS 02 - CLOSE
REPRESS PKG VLV - FILL
Verify repress 02 press increasing
CRYO 02 PRESS 1 ind - 865-935 psia
02 PRESS IND sw - TK 1
REPRESS PKG vlv - OFF

CM EQUIPMENT JETTISON

CREW STATUS

At crew stations
UCTA donned and empty
Helmets stowed in helmet stowage bag
Gloves stowed
Comm carrier donned
02 hoses connect red/red, blue/blue
SUIT FLOW vlv - SUIT FULL FLOW
SUIT RETURN vlv - OPEN (PULL)
EMER CAB PRESS sel - BOTH
Chronometers on left PGA sleeve
Inspect PGA zipper-verify lock-lock

SYSTEMS PREPARATION FOR DEPRESS

Verify repress 02 pressure
  865-935 psi
EMERGENCY 02 valve - CLOSED
REPRESS 02 valve - CLOSE
Verify surge tank vlv - ON
02 Press ind sw - SURGE TANK
Verify surge tank pressure
  865-935 PSIA

EQUIPMENT PREPARATION FOR DEPRESS

Stow loose items
Prepare all equipment to be
  jettisoned and secure
    PLSS (1-2)
    RCU (1-2)
    OPS (1-2)
    PURGE VALVE (1-2)
    LIFELINE (1)
    LEVA'S (2)
    WAIST TETHERS (2)

PREP FOR CABIN DEPRESS

Verify PGA diverter valves -
  horizontal

Unstow helmet
Verify feed port cover installed
and locked, wipe helmet with anti-fog
Position mikes, don helmet and "lock"
Secure helmet stowage bags
Don gloves and lock
SUIT RETURN vlv - CLOSE (PUSH)
EMER CAB PRESS sel - OFF
Check all PGA connections and verify
lock-lock

PRESSURE INTEGRITY CHECK (DECAL)

1 DIRECT 02 - CLOSE (CW)
2 SUIT PRESS ind - 4.7-5.3 psia
3 02 FLOW ind - 0.2-0.4 LB/HR
4 SUIT TEST vlv - PRESS (DIR 02 - OPEN,
At 4.0 psig, DIR 02 - OFF)
5 02 FLOW ind - 1.0 LB/HR (pegged)
6 02 FLOW HI LT - ON
7 MASTER ALARM PB/LT (3) - ON (PUSH)
8 CYCLE SUIT CKT RTN AIR vlv OPEN and
CLOSE At SUIT PRESS of 1.5-2.0 psig
9 SUIT PRESS ind - 8.8-9.8 psia
10 PGA PRESS ind - 4.1-4.5 psig
11 02 FLOW HI LT - OUT
12 Allow 02 FLOW To Stabilize 15 sec
13 02 FLOW Shall Remain Below 0.8 LB/HR
For 30 sec After Stabilization
14 SUIT TEST vlv - DEPRESS
15 02 FLOW ind - 0.2-0.4 LB/HR
16 SUIT PRESS ind - Slight > CABIN
PRESS ind
17 SUIT TEST vlv - OFF
18 Verify DEMAND REG SEL - BOTH

CABIN DEPRESS (DECAL)

1 CABIN FAN (2) - OFF
2 REPRESS PKG 02 vlv - FILL
3 REPRESS 02 vlv - CLOSE (verf)
4 CAB PRESS REL vlv (2) - NORMAL

5 SIDE HATCH DUMP vlv - OPEN
(02) FLOW HI WARNING LT May Come On
Prior To CABIN PRESS REG LOCK UP)
6 At 3.25 psia, SIDE HATCH DUMP vlv - CLOSE
7 02 FLOW ind - LESS THEN 0.5 LB/HR
8 CABIN PRESS 3.25 psia
9 SUIT CKT PRESS STABLE 3.5-4.0
10 SIDE HATCH DUMP vlv - OPEN
11 CABIN PRESS ind - 0

HATCH OPENING (DECAL)

1 GN2 vlv HANDLE - PULL
2 GAGE READS - MIN
3 LOCK PIN RELEASE KNOB - UNLOCK
4 LOCK PIN INDICATOR RELEASED
5 GEAR BOX SEL - UNLATCH
6 ACTR HANDLE SEL-U
7 UNSTOW ACTR HANDLE
8 UNLOCK HATCH
9 ACTR HANDLE SEL-L
10 STOW ACTR HANDLE
11 GEAR BOX SEL-LATCH
12 OPEN HATCH

EQUIPMENT JETTISON

JETTISON EQUIPMENT -
PLSS (1-2)
RCU (1-2)
OPS (1-2)
PURGE VALVE (1-2)
LIFELINE (1)
LEVA'S (2)
WAIST TETHERS (2)

HATCH CLOSING (DECAL)
1 CLOSE HATCH
2 LOCK HATCH
3 Verify LOCK PIN Dropped in
4 STOW ACTR HANDLE
5 ACTR HANDLE SELECT-N
6 GEAR BOX SEL - LATCH (verify)

CABIN REPRESS (DECAL)

1 SIDE HATCH DUMP vlv - CLOSE
2 REPRESS 02 vlv - OPEN (10 sec)
  Then CLOSE
3 CABIN PRESS approx - 1.0 PSIA
4 CABIN PRESS ind - monitor for
  gross leakage (30 sec)
5 REPRESS 02 vlv - OPEN
6 Control Surge Tank Press >150 psia
7 REPRESS PKG vlv - OFF
8 CABIN PRESS ind - 3.0 psia
9 REPRESS 02 vlv - CLOSE
10 Dump OPS into cabin (if avail)
11 CABIN REPRESS vlv - OPEN (CW)
12 Maintain Surge Tank Press >150 psia

SYSTEM CONFIGURATION

CAB PRESS ind - 4.7 - 5.3 psia
02 PRESS IND sw - TANK 1
CAB REPRESS vlv - OFF (CCW)
DOFF GLOVES AND HELMETS, IF REQ'D
If helmets and gloves doffed - EMERG CAB PRESS sel - BOTH
SUIT RET vlv - OPEN (PULL)

POST EVA CABIN CONFIGURATION

EXT LTS - RUN/EVA - OFF (down)
Perform as desired
(a) Recharge Repress PKG
(b) Change crew stations
(c) Restow tool B & jack screws
(d) Unstow & install PGA bag
(e) Reinstall center couch
(f) Connect counterbalance (Pip pin in ~~R-10~~ A-1)

LOI 30 MIN DPS ABORT

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

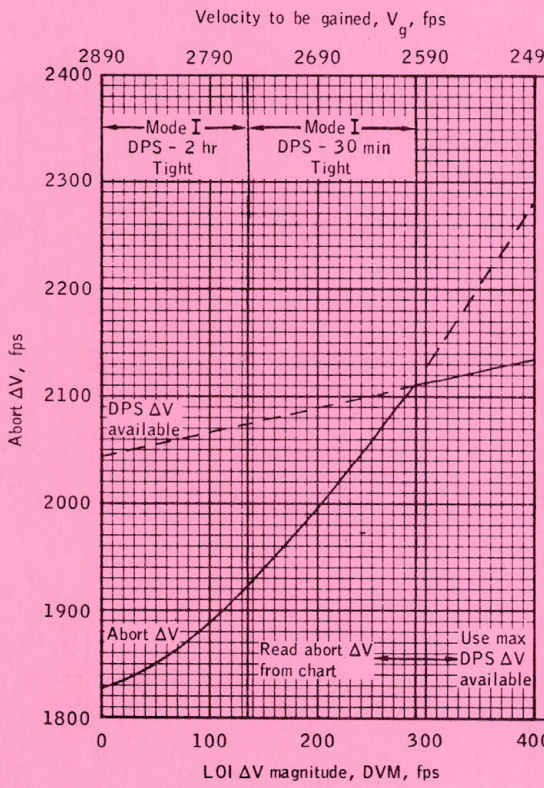
RECORD DATA AND COMPUTE PAD

F 97 40
Record TFC _____
VG _____
ΔVM _____
EMS ΔVC _____
ENTR
F 99 40
ENTR
F 16 85
Record VGX _____ R _____
VGY _____ P _____
VGZ _____ Y _____
PRO
F 37 00E
When CMC ACTY lt out:
V66E

ALTERNATE
ΔVC LOI1 PAD _____
EMS ΔVC(Shutdown) _____
ΔVC(Burned) _____
ΔVC ABORT(Chart) _____

PRIMARY
G&N ΔVM _____
ΔVC ABORT(Chart) _____

GET LOI1 _____
+30:00
GET TEI ABORT __:__:__



ΔVM	Mode	SPS	Type
290 - 650	I	Tight	DPS 30/SPS or APS 2 1/2
650 - 1060	II	Loose	DPS 2/DPS + SPS or APS at per
1060 - 1270	II	Loose	DPS 2/DPS at per
1270 - 1600	III	Loose	DPS at per
1600 - Cutoff	III	Tight	DPS at per

TIGHT SPS

FUEL/OXID ΔP>20 CONF BY LOW P_c

PROP TANK PRESS <160 CONF BY LOW P_c

P_c <80 PSI OR P_c DROPS 10 PSI

BALL VLVS-FAIL OR CLOSE PREMATURELY

AND OTHER GN_2 DECAYS TO 1500

1) SHUT DOWN DECAYING BANK

2) CONTINUE IF BURNING

LOOSE SPS

P_c <70 PSI

PROP TANK PRESS <115

CONFIRM BY LOW P_c

ERRATIC ENG (PHY CUE)

CSM gimbal angles:

R = 295 _____

P = 268 _____

Y = 333 _____

F
13-2

CSM 108

Basic Date October 6, 1969

Changed October 27, 1969

1 MNVR TO PAD BURN ATTITUDE
V62E

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

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

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

5 F 50 18 REQ TRIM MNVR TO FDAI RPY ANGLES
(TRIM) PRO To 4
(BYPASS) ENTR
EMS FUNC - OFF set ΔVC = +100.0
EMS FUNC - ΔV

28:00
(-02:00) V37E 47E
F 16 83 ΔV XYZ(CSM) (.1fps)

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

29:30
(-00:30) EMS MODE - NORMAL

29:58
(-00:02) CMC MODE - FREE (on LM request)

30:00
(00:00) DPS IGNITION

RECORD ΔV COUNTER & RESIDUALS

ΔVC _____
VGX _____
VGY _____
VGZ _____

(RECYCLE) V32E
(TERM) PRO

F 37 XXE

EMS FUNC - OFF
EMS MODE - STBY

LOI DOCKED APS ABORT
TIG(__:__:__)

	50:00 (-10:00)	START DET	
1		MNVR TO PAD BURN ATTITUDE V62E	
2		V49E	
	F 06 22	NEW ICDU ANGLES RPY Load desired angels PRO	(.01°)
3	F 50 18	REQ MNVR TO FDAI RPY ANGLES	(.01°)
	(AUTO)	BMAG MODE (3) - RATE 2 SC CONT - CMC CMC MODE - AUTO	
		PRO	
	(MAN)	MNVR - To 5	
4	06 18	AUTO MNVR TO FDAI RPY ANGLES	(.01°)
5	F 50 18	REQ TRIM MNVR TO FDAI RPY ANGLES	
	(TRIM)	PRO To 4	
	(BYPASS)	ENTR	
	54:00 (-06:00)	CMC MODE - FREE SC CONT - SCS BMAG MODE(3) - ATT 1/RATE 2 V48E, 61102, 01111 EMS FUNC - OFF EMS FUNC - ΔV set ΔVC = +100.0	
	58:00 (-02:00)	V37E 47E	
	F 16 83	ΔV XYZ(CSM)	(.1fps)

VI,HDOT,H available by N62
*KEY RLSE to return to N83 *

Basic Date October 6, 1969
Changed ~~October 27, 1969~~ November 7, 1969

59:30 (-00:30)	EMS MODE - NORMAL
59:58 (-00:02)	SC CONT - CMC (on LM request) BMAG MODE(3) - RATE 2
00:00	APS IGNITION
	RECORD ΔV COUNTER & RESIDUALS ΔVC _____ VGX _____ VGY _____ VGZ _____
(RECYCLE)	V32E
(TERM)	PRO
F 37 XXE	
	EMS FUNC - OFF EMS MODE - STBY

Basic Date October 6, 1969
Changed October 27, 1969

FLIGHT EMERGENCY PROCEDURES

FIRE/SMOKE IN CM (CREW SUITED)

1 CAB FAN (2) - OFF (verify)

2 Monitor EPS for excessive current and remove power from affected bus

3 Verify suit compressor on good AC bus

4 Use fire extinguisher as appropriate

FIRE IS OUT

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

5A Reconfigure per Bus Lost Reconfiguration List pg F/14-8

FIRE PERSISTS - DUMP CABIN

6 Verify:

SUIT CKT RET vlv - CLOSE (push)

EMER CAB PRESS vlv - OFF

REPRESS PKG vlv - OFF

7 Visually check suit integrity

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

9 Verify Suit pressure >3.5 psia

10 CAB PRESS REL (RH) - DUMP
and/or CAB PRESS DUMP vlv - OPEN

11 CAB PRESS ind 0.0 psia for 6 min

12 CAB PRESS REL (RH) - NORMAL

13 CAB PRESS DUMP vlv - CLOSE

14 Do not repress cabin until fire source is removed

FIRE/SMOKE IN CM (CREW UNSUITED)

1 CAB FAN (2) - OFF (verify)

2 SUIT COMPR (2) - OFF

3 Monitor EPS for excessive current and remove power from affected bus

4 Don emergency O2 masks

5 Use fire extinguishers as appropriate

FIRE IS OUT

6 Remove smoke from cabin per "Contamination in CM" procedure before removing O2 masks

6A Reconfigure per Bus Lost Reconfiguration List, pg F/14-8

FIRE PERSISTS - DON SUITS and DUMP CABIN

7 Don PGA's except helmets and verify O2 connectors (Use O2 masks as long as possible)

8 DIRECT O2 vlv - OPEN
Purges suit circuit of smoke and fumes

9 Don helmet

10 SUIT FLOW vlv (3) - SUIT FULL FLOW

Basic Date October 6, 1969
Changed
CSM 008

11 SUIT COMPR 1 (2) - AC1 (AC2)

12 DIRECT O2 vlv - CLOSE

13 EMER CAB PRESS vlv - OFF

14 Visually check suit integrity

15 CAB PRESS REL (RH) - DUMP to 3.0 psia then to BOOST/ENTRY

16 Verify Suit pressure holding >3.5 psia

17 CAB PRESS REL (RH) - DUMP and/or CAB PRESS DUMP vlv - OPEN

18 CAB PRESS ind 0.0 psia for 6 min.

19 CAB PRESS REL (RH) - NORMAL

20 CAB PRESS DUMP vlv - CLOSE

21 Do not repress cabin until fire source is removed

Contamination in CM

1 Don O2 masks and/or PGA's immediately

2. Evaluate contamination level (isolate & correct source of contamination if possible) and proceed with one of the following steps:

a. Retain O2 masks or remain in suit and accept contamination level in cabin.

CAUTION

If in PGA's, adjust DIRECT O2 to maintain suit to cabin ΔP >+2 in. H20

b. Retain O2 masks and scrub cabin atmosphere through suit loop. If initially suited, establish partially suited or shirtsleeve configuration and don O2 masks.

CAUTION

Change LiOH cartridges after scrub completed.

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

Contamination In Suit

1 SUIT COMPR 2 - AC1

2 SUIT COMPR 1 - OFF

3 DIRECT O2 vlv - OPEN for 1 minute then CLOSE

If condition persists:

4 SUIT COMPR 2 - OFF

5 DIRECT O2 vlv - CLOSE

6 Doff helmet

7 Don emergency O2 masks

C&W/MALFUNCTION INDICATORS

CMC

SC CONT - SCS, If out in 5 sec G&N 5
V11 N10E 33E:R1:A:
if R1A≠0,1,4,5: C/W fail (if LEB, CMC, no TVC)

Basic Date October 6, 1969
Changed
M 108

ISS	SC CONT - SCS, G&N PWR - AC1 Both Lamps on: G&N PWR - OFF,check V5N9 One lamp: V35 for lamp test	G&N 6
TEMP	RSET, If V11 N10E, 30E, R1A=0,1,2,3:Temp in limits If not, 15 min available.	G&N 7
SPS PRESS	FUEL/OX ΔP < 20: P>200 He vlv - OFF; <157: ON > 20: ΔV THRUST - OFF	SPS 1
SM RCS	He 1 & 2 CLOSE PKG TEMP <75° RCS HTRS - SEC >205° RCS HTRS - OFF <55° QUAD AUTO RCS - OFF	RCS 1
CM RCS	MANF PRESS <260, He PRESS Low: CM RCS PRPLNT - OFF	RCS 3
CRYO PRESS	Any Lo: FANS and HTRS - ON Both Hi: FANS and HTRS - OFF: Any Hi: Inst fail	EPS CRYO 1
FC 1	Skin Temp >450°: HTRS Off,Check VI Perf <360°: Check VI Perf Con Ex Temp >225°: Open CKT, Check RAD OUT TEMPS (3B,3C,3D) <150°: Check cb FC PUMPS AC, Check T skin Hi (450°) Rad Temp Lo: Check TCE,RAD OUT TEMPS Ph Hi-bp: If current <5 amps, shutdown: PUMPS - OFF POTABLE TANK INLET vlv - CLOSE	EPS FC 1a 1b EPS 1c 1d 1e 1f

FC O2 (H2) FLOW HI .8(.1)	O2 < (8)(H2):	Cycle Purge	EPS
	O2 > (8)(H2):	Check amps vs. flow	FC 1g
FC O2 (H2) FLOW LOW	O2 < (8)(H2):	Check REG PRESS: 10(2C)	EPS
	O2 > (8)(H2):	Check VI perf	FC2
AC BUS 1	RSET: < 98:	Replace Inv.	EPS-PD
	>128:	Replace Inv.	1d
	NORM:	EPS Sensor Unit Out, RESET-OFF	1e 1b
AC BUS + MAIN BUS UNDERVOLT	DC Volts <26, AMPS Hi: Replace Inv.		EPS 3

BUS B UNDER + BUS A UNDER + FC 3 + FC 2

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

AC BUS + AC BUS OVERLOAD + MAIN BUS UNDERVOLT

Remove INV — SSR-2
AC BUS SHORTED

MAIN BUS UNDER	Volts <26, AMPS Hi: Replace Inv.		
INV TEMP HI	Gly Out Temp >51: SEC EVAP - ON,		ECS-16
	Gly Out Temp <51: AC volts, Replace INV		EPS-PD 2
FC BUS DISCONNECT	1 or 3:	Connect 1 to B, 3 to A	
	2 :	Attempt Reconnect	
O2 FLOW HI	Indicator, Cabin Press, Surge OK: Waste Mgt Valve Cabin Press Rel; DIRECT O2; Demand Reg; REPRESS O2; Emerg. Reg; H2O/Gly Tank Reg. LM PRESS vlv		

Basic Date October 6, 1969
Changed October 27, 1969

M 108

SUIT COMPRESSOR	ΔP <.22, other comp to other bus	ECS 9
CO2 PP HI	>7.6mm: Direct O2 10 sec, O2 Mask	ECS 12
GLYCOL TEMP LOW	Prim Rad Out T <-30: ECS RAD HTR - PRIM 2 Still <30: RAD FLOW CONT - 2	ECS 14
GLY EVAP TEMP HI	>60° Actuate Secondary Loop	ECS 16

EMERGENCY POWER DOWN
(MN BUS Voltage <26.0, no short verified, Powerdown until MN BUS ≥ 26.5 vdc)

SPS BURN	AMPS
O2 HTRS (2) - off (ctr)	11.05
BAT C on MNA&B	
cb MNA BAT C - close	
cb MNB BAT C - close	
ECS RAD HTRS (2) - OFF	17.2 per HTR
If unsuited	
SUIT COMPR - OFF	4.00
S BD PWR AMP - off (ctr)	4.00
FC PUMPS (3) - OFF	8.73
SM RCS HTRS (4) - OFF	2.90 per quad max
POT H2O HTR - OFF	1.62
H2 HTRS (2) - off (ctr)	1.43
H2 FANS (2) - off (ctr)	0.72
O2 FANS (2) - off (ctr)	5.4
SPS LINE HTRS - off (ctr)	3.09
	6.17
LIGHTS (min req'd)	1.57
TAPE RCDR FWD - off (ctr)	1.57
SPS GAUGING - OFF	2.96
ECS GLY PUMPS (2) - OFF	2.57 per pump
cb ECS RAD CONT/HTR (2) - open	1.05
SCE PWR - off (ctr)	0.65
TELECOM GRP 1&2 - OFF	3.71
cb INSTR ESS (2) - open	4.80

October 6, 1969
Basic Date
Changed
CCN 108

BUS LOSS RECONFIGURATION

A Loss of MN BUS A

FC 2 - MNB only
FC 1 - MNB (if req'd)
FC 1 - MNA - OFF
INV 1 AC1 - OFF
INV 1 - OFF
INV 3 - MNB, AC1
cb MNA BAT BUS A - open
cb MNB BAT C - closed
SUIT H2O ACCUM AUTO - 2
BMAG MODE (3) - RATE 2
FDAI SEL - 2
URINE DUMP - HTR B
WASTE H2O DUMP - HTR B
RHC PWR DIR 2 - MNB
AUTO RCS SEL (16) - MNB (as req'd)
ECS RAD HTR - PRI 1
SPS LINE HTR - A/B (as req'd)
RAD FLOW CONT AUTO - 2
SCS TVC (P&Y) - RATE CMD
Use RHC'S for RCS dump, not CM PRPLNT DUMP Sw

B Loss of MN BUS B

FC 2 - MNA only
FC 3 - MNA (if req'd)
FC 3 MNB-OFF
INV 2 AC2 - OFF
INV 2 - OFF
INV 3 - MNA, AC2
cb MNB BAT BUS B - open
cb MNA BAT C - closed
BMAG MODE (3) - RATE 1
RHC PWR DIR 1 - MNA
AUTO RCS SEL (16) - MNA
SCS ELEC PWR - ECA
ECS RAD HTR - PRI 2
RAD FLOW CONT AUTO - 1
Use RHC'S for RCS dump, not CM PRPLNT DUMP Sw

Basic Date October 6, 1969
Changed
CSM 008

C Loss of BAT BUS A

ECS RAD HTR - PRI 2
cb PYRO A SEQ A - open
If MN BUS TIE A/C is closed
  cb MNA BAT BUS A - open
  cb MNB BAT C - open (verify)
  For Subsequent Main Bus Ties,
  cb MAIN A BAT C - closed
  MAIN BUS TIE BAT B/C-on (up)
If MN BUS TIE A/C is open
  cb MNB BAT BUS B - open
  cb MNA BAT C - open (verify)
  MN BUS TIE BAT B/C - on (up)
  For Subsequent MAIN BUS TIES,
  cb MAIN A BAT C - closed
  cb MAIN B BAT BUS B - closed

D Loss of BAT BUS B

ECS RAD HTR - PRI 1
cb PYRO B SEQ B - open
If MN BUS TIE B/C is closed
  cb MNB BAT BUS B - open
  cb MNA BAT C - open (verify)
  For Subsequent MAIN BUS TIES,
  cb MAIN B BAT C - closed
  MAIN BUS TIE BAT A/C - on (up)
If MN BUS TIE B/C is open
  cb MNA BAT BUS A - open
  cb MNB BAT C - open (verify)
  MN BUS TIE BAT A/C - on (up)
  For Subsequent MAIN BUS TIES,
  cb MAIN B BAT C - closed
  cb MAIN A BAT BUS A - closed

E Loss of AC BUS 1

AC INV 1 MNA - OFF
AC INV 1 AC 1 - OFF
SUIT COMPR 2 - AC2
FDAI SEL - 2
BMAG MODE (3) - RATE 2
S BD NORMAL PWR AMP - SEC
S BD NORMAL XPONDER - SEC
FC PUMP 1 - AC2
ECS GLY PUMP 2 - AC2
BMAG 1 PWR - OFF

G/N PWR - AC2
SIG CONT/BIAS PWR 1 - AC2
Maintain GLY EVAP TEMP INLET temp above 40°F
RAD FLOW CONT AUTO - 2
BAT CHGR - AC2

F Loss of AC BUS 2
AC INV 2 MNB - OFF
AC INV 2 AC 2 - OFF
SCS ELEC PWR - ECA
Verify OMNI in proper configuration for MSFN
FC PUMP 2&3 - AC1
BMAG 2 PWR - OFF
FDAI SEL - 1
SIG COND/BIAS PWR 2 - AC1
BMAG MODE (3) - RATE 1
Activate SEC COOL LOOP
Shut down PRIM EVAP

PRE/POST SPS BURN

A. Loss of MN BUS A
Pre SPS Burn
Verify reconfiguration per mission phase
Perform G&N SPS maneuver with
following deviations:
cb MNB BAT C - close
TVC GMBL DR (P&Y) - 2
cb SPS P2, & Y2 (2) - open
(after SEC GMBL MTR turn on and prior to IGN)
Post SPS Burn
cb SPS P2, & Y2 - close
(prior to SEC GMBL MTR turn off)

B. Loss of MN BUS B
Pre SPS Burn
Verify reconfiguration per mission phase
Perform G&N SPS maneuver with
following deviations:
cb MNA BAT C - close
TVC GMBL DR (P&Y) - 1
cb SPS P1, & Y1 - open
(after PRI GMBL MTR turn on and prior to IGN)

Basic Date October 6, 1969
Changed
CSM 008

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

C. Loss of BAT BUS A

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

TVC GMBL DR (P&Y) - 2 (if bus lost prior to GMBL Mtr turn on)
If GMBL MTRS OFF,
Sec Gmbl Mtrs (2)-on (up)
cb SPS P2 & Y2 (2) - open
(After sec gmbl mtr turn on & prior to Ign)

Post SPS burn
cb SPS P2, & Y2 - closed
(prior to sec GMBL MTR turn off)

D. Loss of BAT BUS B

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

TVC GMBL DR (P&Y) - 1 (If bus lost prior to GMBL Mtr turn on)
If GMBL MTRS - OFF,
Pri GMBL Mtrs (2)-on (up)
cb SPS P1, & Y1 - open

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

E. Loss of AC BUS 1

AC INV 1 MNA - OFF
S BD NORM PWR AMP - SEC
S BD NORM XPNDR - SEC
FC PUMP 1 - AC2

G/N PWR - AC2
ECS GLY PUMP 2 - AC2
SUIT COMP - AC 2
BMAG 1 PWR - OFF
SIG COND/BIAS PWR 1 - AC2
FDAI SEL - 2
SCS TVC (2) - RATE CMD
BMAG MODE (3) - RATE 2
TVC SERVO PWR 1 - AC2/MNB
SPS GAUGING - AC2

F. Loss of AC BUS 2
AC INV 2 MNB - OFF
Verify proper ONMI configuration for MSFN
FC PUMP 2&3 - AC1
BMAG 2 PWR - OFF
FDAI SEL - 1
SCS ELEC PWR - ECA
SCS TVC (P&Y) - RATE CMD
BMAG MODE (3) - RATE 1
TVC SERVO PWR 2 - AC1/MNA

DURING CRITICAL SPS BURNS

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

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

C. Loss of AC BUS 1

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

D. Loss of AC BUS 2

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

E. Loss of BAT BUS A

cb MNA BAT C - closed

F. Loss of BAT BUS B

cb MNB BAT C - closed

LOSS OF TWO FUEL CELLS

1. Power down the following:

Panel 2

O2 & H2 FANS & HTRS - OFF
C/W NORM - ACK
POT H2O HTR - OFF
GLY EVAP STM AUTO - MAN
GLY EVAP H2O FLOW - off (ctr)
GLY EVAP IN TEMP - MAN
ECS RAD HTRS (2) - OFF
Power down IMU and CMC to STBY per checklist

Panel 3

SPS LINE HTR - off (ctr)
TAPE RCDR FWD - off (ctr)
S BD NORM PWR AMP - off (ctr)
Select single inverter operation
Configure remaining fuel cell to both main busses

Panel 5

cb ECS RAD HTR OVLD (2) - open
Do not reset cb's unless batteries are tied to the main buses.
Failed FC PUMPS (2) - OFF

Panel 7

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

Panel 8

AUTO RCS SEL (16) - OFF
cb SCS LOGIC (4) - open
cb SPS P1 & Y1 (2) - open

2. IGN - 2 hrs
   a. Power up CMC, IMU, and OPTICS per checklist and perform IMU align (crew option)

   b. After IMU align OPT PWR - OFF

   c. If main bus voltage 26.0 vdc with CMC, IMU, and OPTICS up perform the following:
      1) If sufficient battery energy is available, place battery with highest energy on both main busses.

      2) If insufficient battery energy available perform:
         SM RCS HTR - OFF
         ECS GLY PUMP - OFF (to be turned back on within 1 1/2 hrs)
         SUIT COMPR - OFF (to be turned back on within 1 hr)
         cb INSTR ESS (2) - open (to be closed when the batts are on line) (crew option)
         Lights - as req'd

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

   Arm logic
   Arm pyros
   Press CM RCS
   Safe pyros
   Safe logic

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

NON DIODED/NON SWITCHABLE LOADS

MAIN BUS A

EPS/CRYO

Tank 1 H2 & O2 Htrs
Inverter 1 Pwr
Utility Outlets Pnl 15 & 16
Tank 1 O2 Vac-Ion Pump

ECS

CO2PP Ind, CW Lt & PCM
Prim 2 Rad Htr Control
Rad Flow Controller 1 & Auto Select
Rad Isol Vlv Manual Select
H2O Accum 1 Auto & Manual Control
Urine & Waste H2O Dump Htr A
Steam Duct Htr A
Sec Rad Htr Control
Sec Rad In & Out Temp Ind & PCM

Basic Date October 6, 1969
Changed
CSM 108

RCS

CM Sys 1 Htrs
CM Sys 1 Fuel & Oxid Purge
CM Oxid Interconnect
CM Fuel/He Interconnect
CM Sys 1 Prop Dump 42 Sec TD
CM Sys 1 Prop Isol Vlv & TB
SM B & D Htrs
SM B & D He 1 & 2 Isol Vlv & TB
SM B & D Prim/Sec Prop Isol Vlv & TB
SM B & D Sec Fuel Press Isol Vlv
Transfer Mtr Sw 1

SPS

P & Y (Prim) Gmbl Mtrs
Enable Pwr Sol Driver 1
He Vlv 1 & TB
Pilot Vlv 1 & 2
Prim Pilot Pre Vlv
Line Htrs A
PUGS Test

SCS

FDAI 1 Total Attitude
GDC (except RSI)
BMAG 1 Htr & CW Temp Lt (Eventually lose
BMAG1 as TEMP Decreases)
Auto Coils CM RCS 1 (if
prior to CM/SM sep)
Direct Ullage Pitch C3 & A4
Auto ΔV
Auto Attitude Hold
Rate 1 MTVC
Rot Cont Pwr Dir 1
a. MNA/MNB to Half of Jets
b. MNA to All Jets
Rot Cont Pwr Dir 2, MNA/MNB
to Half of Jets

LIGHTING

RH Girth Shelf Flood (Fixed Mode)
RH Couch Flood (Fixed Mode)
LH Girth Shelf Flood (Variable Mode)
LH Couch Flood (Variable Mode)
LH & RH Strut Flood (Variable Mode)
LH Optical Align Sight
Rendezvous Lt
Sys A Tunnel Lts (6 elements)

DISPLAYS & CONTROLS

Mission Elapsed Timer Pnl 2

DOCKING

Sys A Probe Connector
(however A & B connectors
may be switched)

MAIN BUS B

EPS/CRYO

Tank 2 H2 & O2 Htrs
Inverter 2 Pwr
Utility Outlet Pnl 100
LM Power
Tank 2 O2 Vac-Ion Pump

ECS

O2 High Flow CW Lt
Prim 1 Rad Htr Control
Rad Flow Controller 2
Prim Rad in Temp Ind & PCM
H2O Accum 2 Auto & Manual Control
Urine & Waste Dump Htr B
Steam Duct Htr B

RCS

CM Sys 2 Htrs
CM Sys 2 Fuel & Oxid Purge
CM Fuel Interconnect
CM Oxid/He Interconnect
CM Sys 2 Prop Dump 42 Sec TD
CM Sys 2 Prop Isol Vlv & TB
SM A & C Htrs
SM A & C He 1 & 2 Isol Vlv & TB
SM A & C Prim/ Sec Prop Isol Vlv & TB
SM A & C Sec Fuel Press Isol Vlv
Transfer Mtr Sw 2

SPS

P & Y (Sec) Gmbl Mtrs
Enable Pwr Sol Driver 2
He Vlv 2 & TB
Pilot Vlv 3 & 4
Sec Pilot Pre Vlv
Line Htrs B

SCS

FDAI 2 Total Attitude
GDC
BMAG 2 Htr & CW Temp Lt (eventually lose
BMAG 2 as Temp decreases)
Auto Coils CM RCS 2 (if prior
to CM/SM sep)
Direct Ullage Yaw D3 & B4
Auto ΔV (maybe degraded)
Min Imp Increase to ∿42 MS
RSI
Ordeal
Rot Cont Pwr Dir 1, MNA/MNB to
Half of Jets
Rot Cont Pwr Dir 2
a. MNA/MNB to Half of Jets
b. MNB to All Jets

LIGHTING

LH Girth Shelf Flood (Fixed Mode)
LH Couch Flood (Fixed Mode)
LH & RH Strut Flood (Fixed Mode)
RH Couch Flood (Variable Mode)
RH Girth Shelf Flood (Variable Mode)
RH Optical Align Sight
Sys B Tunnel Lts (6 elements)
Spotlight Door Initiator

DISPLAYS & CONTROLS

Mission Elapsed Timer Pnl 306

DOCKING

Sys B Probe Connector (however
A & B connectors may be switched)

BAT BUS A

EPS/CRYO

Main Bus Tie A/C Mtr Sw

ECS

Prim Rad 1 Htr Ovld Sensor

RCS

SECS Auto RCS Trnfr to Trnfr Mtr Sw 1

SPS

P & Y 1 (Prim) Gmbl Mtr Control

SCS

Auto RCS Sel MNA (if not previously enabled)

Basic Date October 6, 1969
Changed October 27, 1969
CSM 108

SECS

SECS & ELS Sys A
Float Bag Comp 1
Float Bag 1 Mtr Sw & Control Vlv
EDS Voting Logic 1

BAT BUS B

EPS/CRYO

Main Bus Tie B/C Mtr Sw

ECS

Prim Rad 2 Htr Ovld Sensor
Sec Rad HTR Ovld Sensor

RCS

SECS Auto RCS Trnfr to Trnfr Mtr Sw 2

SPS

P & Y (Sec) Gmbl Mtr Control

SCS

Auto RCS Sel MN B(if not previously enabled)

SECS

SECS & ELS Sys B
Float Bag Comp 2
Float Bag 2 Mtr Sw & Control Vlv
EDS Voting Logic 3

BAT RELAY BUS

EPS/CRYO

FC 1, 2, 3 Reacs Vlvs, Latch Circuit & TBs
FC 1, 2, 3 Rad Bypass Vlvs & TBs
FC 1, 2, 3 to Main Bus A & B Switching & TBs
Main Bus A & B UV Sensing and UV CW Lt if CW NORMAL Sw in ACK
Inv 1, 2, 3 to AC Bus 1 & 2 & DC BUS Switching
AC Over/UV Sensing & CW Lt
AC Ovld CW Lt (if CW NORMAL Sw in ACK)

BATTERY C

EDS Voting Logic 2

AC BUS 1

EPS/CRYO

Tank 1 H2 & O2 Fans
Tank 1 H2 & O2 Qty & Temp Sig COND (ϕC)

ECS

Cabin Fan 1
Man Control Prim Evap Stm Vlv (ϕC)
Auto Control Prim Gly Control Vlv (ϕA)
Sec Loop Evap Cooling (ϕA)
Elect Control Suit Ht Exch Gly Bypass Vlv (ϕB)
Rad Flow Controller 1 & Rad Isol Vlvs (ϕC)

SCS

GDC (all modes except RSI)
FDAI 1
BMAG 1 (ATT HOLD, RATE CMD)
Min Impulse (ϕA)
RHC 1 MTVC (ϕA)
Rate Cmd Prop Att Control (ϕA)
Auto ΔV (ϕA)
No 1 Pitch & YAW Needles on GPI (ϕA)
SII FUEL & SIVB FUEL & OXID PRESS FOR INDICATOR
No. 1 (ϕA)

LIGHTING

FDAI 1
EMS Numerics & Grid
Mission Timer Numerics Pnl 2
DSKY Numerics Pnl 2
EL For Pnls 1-9, 15, 16, 229, 275
Sys 1 SM Running Lts (8 elements) &
EVA Lt (1 element)

PYRO BUS A

FUEL/HE INTERCONNECT
OX INTERCONNECT
CM RCS 1 PURGE VLVS
SEQ SYS A FUNCTIONS (PYROS)

AC BUS 2

EPS/CRYO

Tank 2 H2 & O2 Fans
Tank 2 H2 & O2 Qty & Temp
Sig Cond (ϕC)

ECS

Cabin Fan 2
Prim Evap Temp Control Unit (ϕA)
Auto Cabin Temp Control Unit (ϕC)
Rad Flow Controller 2 & Rad
Isol Vlvs (ϕC)

SCS

MTVC (RATE CMD, ACCEL CMD)
PROPORTIONAL RATE CMC (TVC, ATT CONT)
FDAI 2
BMAG 2
RSI (ϕA)
GDC (ϕA)
Auto ΔV (TVC) (ϕA)
Ordeal
No. 2 Pitch & Yaw Needles on GPI (ϕA)
SII FUEL & SIVB FUEL & OXID PRESS FOR INDICATOR No 2 (ϕA)

LIGHTING

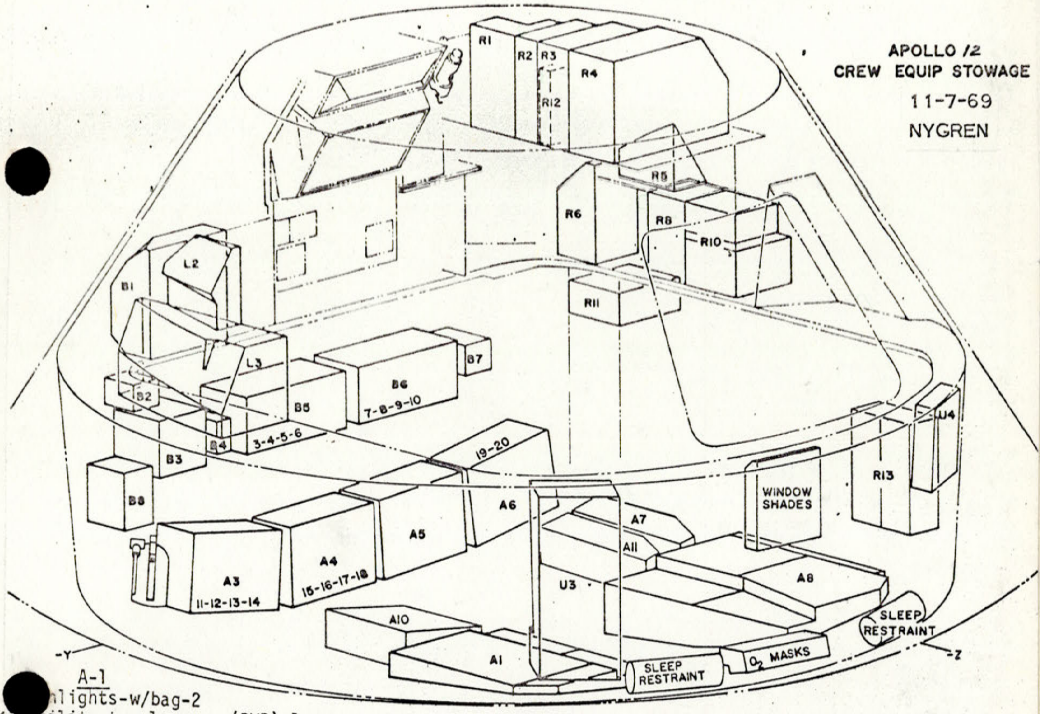
EMS Roll Att & Scroll Lts
Mission Timer Numerics Pnl 306
DSKY Numerics Pnl 140
EL For Pnls 10, 100, 101, 122, 225, 226, 306
Sys 2 SM Running Lts (8 elements) & EVA Lt (1 element)
Docking Target & Spot Lt

PYRO BUS B
OX/HE INTERCONNECT
FUEL INTERCONNECT
CM RCS 2 PURGE VLV
SEQ SYS B FUNCTIONS (PYROS)

Basic Date October 6, 1969
Changed
CSM 1

Basic Date OCTOBER 20, 1969
Changed

TIME	REMARKS



A-1
Inflights-w/bag-2
Utility towel assy. (RWB)-1 ea.
Tissue disp.-5
Snag line w/cont. & strap-1
Temporary stowage cont.-3
Gas separator w/bag-1
PLV duct w/cont.-3
PGA O_2 interconnects w/cont.-3
Sea Dye marker-1
Probe stowage straps-2
Chlorination ampule container-1
Chlorination ampules-4
Buffer ampules-3
Hasselblad camera adapter-1
Tool kit-1
Utility strap-1

A3
CO_2 absorber -4

A4
CO_2 absorber -4

A5
Headrest pads-3
Heel restraints-3 pr.
Sleep restraint rope-5
Instant Adapter [16mm camera]-1
Spotmeter-1
2-speed timer-1

A6
CO_2 absorber-2
TV Monitor w/cable and strap-1
12' TV Cable w/strap-1
TV Camera Bracket-1

A7
TV color camera w/zoom lens-1
Ringsight,T.V.-1

A8
LCG-2
FCS-3
EMU maintenance kit-1
PPK's-3
Inflight exercisor-1
L/W headsets (2/earmold inst.)-3
Relief recp. in cont. w/straps-1
CWG GFE adapters (in one bag)-4
Tissue disp.-2
CWG's-3
Decontamination Bags-7
70mm mags in Bag-2

A10
S-158 Experimental Assy
70mm Elect. Hassel.-4
70mm Mags.-7
Photar Filters,blue,red, orange & 87C-1 ea.
Intervalometer-1
Camera Mount-1

A11
500mm lens-1
Remote control cable-1
70mm camera bracket assy.-1

B1
Food & hygiene-1

B2
16mm mags in bag-4

11-7-69
NYGREN

B3
Lens 18mm-1
Power cable 16mm w/strap-1
Right angle mirror-1
5mm lens w/cover-1
75mm lens-1
16mm data acquisition camera w/magazine inst-1
70mm elect. Hasselbald w/80mm lens & mag. inst-1

B4
Chlorination ampules-3
Buffer ampules-3
Chlorination needle-1
Chlorination syringe casing-1
Chlorination syringe knob-1
Chlorination equip. cont.-1

B5
CO_2 absorber-4

B6
CO_2 absorber-4

B7
Chlorination ampules-3
Buffer ampules-4
Chlorination ampules cont.-1

B8
Voice Recorder w/btry & tape cassette-1
16mm mags-5

L2
Electrostatic ground cable-1
Adapter tool E w/strap-1
CCU control head (spare) w/cont.-1
CCU spare cable w/strap-1

L3
Food packages w/food restrainer pouches and contingency feeding valve adapter

R1
Flight data file books
G&N handles-2
OUA hi density sun filter (G&N)-2
Glare shields (DSKY, EMCA, MET) w/4 straps-1

R2
~~Flight data file books~~ PPK's-5

R3
Flight data file books
Flight data card kit-1
Floodlight glare shield-1
Eye patch-1
Meter cover-2
Fuse, 16mm camera-1
Clip, flt data file-6
G/N align proced-1
(In data card kit)

R4
Survival kits-2

R5
Gas & liquid WMS Q.D. filter assy-2
Inflight retainer strap-3
Back to back straps-6

R6
Helmet bags-3
Accessory bags-3
Tape-1
Cabin vent Q.D.-1

R8
Medical kit (w/UCTA roll-ons)

R10
Fecal collection assy.-30
Sanitation supply box (aft)-1
Sanitation Supply box (fwd.)-1
Coupling assy water panel-1
H_2O panel Q.D.-1
WMS press. cap Q.D.-1
WMS power cable-1

R11
Roll on cuffs (RWB)-1 pkg. ea.
UTS w/roll-on- 1
UTS spare - 3

R12
Flight data file books

R13
16mm mags in one bag-6
Passive dosimeter (in 16mm mag bag)-1
70mm mags in one bag-3
70mm mags in one bag-2
Jettison stowage bag-1

U3
Docking target adapter-1
16mm camera bracket-1
LM docking target-1
COAS light bulb-2
COAS filter-1

U4
Recorder tape cassettes-4
Recorder battery packs-4
Monocular-1
Intervalometer-1
250mm lens-1

MISC
Fwd hatch cont (under LH couch)-1
Radiation survey meter (G&N panel LEB)-1
Urine hose assy w/cont.-1
Inflight retainer strap-1 (aft blkd.under A6)
UCTA xfer adapter-1
CCU control head (on CCU)-3
Shades w/cont (on UEB O_2 repress.sys)-5
Fire extinguisher (on side of A3)-1
COAS w/bulb (above L/H window)-1
CO_2 absorber (in ECU)-2
O_2 mask & hose w/utility straps & cont. (O_2 repress. system)-3
Rest restraints (L,R,C) (aft UEB)-1 ea.
UCTA clamps-3
O_2 screen caps-3
Couch straps-3
ICG w/univ. eartubes in jacket pocket-3
PGA elec. conn. covers-3
Helmet shield-1
(in PGA bag under center couch)
Verb/noun list (G&N)(on GNIC panel)-1
Closeout curtains, B5 & B6(on B5 & B6)
Accoustic tone booster in bag (under A-3)-1
Vacuum brushes-2 & hose-1 in bag (side of A-8)
Calfax adapter plate assys.,R&L (R&L LEB)-2 ea.
Data retention snap assys., hook assys., snap clamps & spring clips (Closeout curtain pockets in pouches)
Snap adapters, food compt. (on B1 door)-6
Harness straps (on trans. & rot. hand contr.)-3

CM-108 ENTRY STOWAGE CHANGES FROM EARTH LAUNCH

A. (LM to CM XFER) ADDITIONS

QTY	NAMENCLATURE	CM STOWAGE LOCATION/VOLUME
2	PPK's	R13
1	DSEA	R13
1	SRC #1	B5 (In Decontam. Bag From A8)
1	SRC #2	B6 (In Decontam. Bag From A8)

NOTE: Solar Wind 1 Ea. and Weigh Bag 1 Ea. IN SRC

1	Contingency Sample	A5 (In Decontam. Bag From A8)
1	CSC Cassette	A5 (In Decontam. Bag From A8)

B. (CM to LM XFER) - Final Docking - Off Load

QTY	NOMENCLATURE	CM STOWAGE LOCATION/VOLUME
1	Vacuum Brush & Hose	From Side of A8
1	B5 Container W/4 CO_2 Absorbers	From B5
1	B6 Container W/4 CO_2 Absorbers	From B6
1	Docking Probe	From Tunnel
1	Jettison Stowage Bag	From R13

C. CM-108 Relocations - For Re-Entry

QTY	NOMENCLATURE	LAUNCH STOW	RE-ENTRY STOW
3	Helmet Stowage Bags	3 Ea. R6	1 Ea. R6/B1/L3
3	Accessory Bags	3 Ea. R6	1 Ea. R6/B1/L3
3	ICG	PGA Container	3 Ea. On Crew
3	Headrest Pad	3 Ea. A5	3 Ea. On Couch
3	Heel Restraint	3 Ea. A5	3 Ea. On Crew
4	CWG Elect. Adapter	4 Ea. A8	3 Ea. On Crew 1 Ea. A8
3	CWG Elect. Adapter Cover	3 Ea. PGA Cont.	3 Ea. On PGA
1	Verb/Noun List	1 Ea. Installed	1 Ea. Data Card Kit
2	PGA-EV	2 Ea. On Crew	2 Ea. PGA Container

QTY	NOMENCLATURE	LAUNCH STOW	RE-ENTRY STOW
2	Gloves, EV-Pr.	2 Ea. On Crew	2 Ea. Accessory Bags In Helmet Bags 1-B/1-L3
2	Helmet	2 Ea. On Crew	2 Ea. in Helmet Bags 1-B1/1-L3
1	PGA-IV	1 Ea. On Crew	1 Ea. RH Sleep Restraint
1	Helmet	1 Ea. On Crew	1 Ea. RH Sleep Restraint
1	Gloves, IV-Pr.	1 Ea. On Crew	1 Ea. RH Sleep Restraint
7	Decontamination Bags	7 Ea. A8	1 Ea. W/70MM Mag. R13
			1 Ea. W/70MM Mag. R13
			1 Ea. Conting. Sample A5
			1 Ea. CSC Cassette A5
			1 Ea. SRC #1-B6
			1 Ea. SRC #2-B5
			1 Ea. Surveyor On A1

1. REFERENCE DATA 1-1
Star List 1-1
Verb List 1-2
Noun List 1-4
V05 N09 Alarm Codes 1-8
V50 N25 Checklist Codes 1-14
V04 N06 Option Codes 1-14
Flag Word Listing 1-15

2. G&N GENERAL 2-1
CMC Power Up Procedure 2-1
IMU Power Up Procedure 2-1
Optics Power Up Procedure 2-1
P06 CMC Power Down Program 2-2
IMU Power Down Procedure 2-2
Optics Power Down Procedure 2-2
CMC Self Check 2-2
Measurement and Loading of PIPA Bias 2-3
Flag Word Set/Reset 2-3
Binary/Octal/Decimal Conversion 2-4
Review/Change Data in Erasable Memory 2-5
P22 Raw Data Readout 2-5
Monitor of Input/Output Channels 2-6
Load Output Channels 2-6
Pitch Orbit Rate Maneuver 2-6
RCS DAP ATT DB Increase 2-7
VHF RNG DSKY DISPLAY 2-7
G&N Recovery Procedure 2-8
Rapid IMU Realign 2-9
Changing Landing Site REFSMMAT For Out-of-Plane Burns 2-9

3. NAVIGATION (P17,P20's) 3-1
P17 TPI Search (P77 LM) 3-1
P20 Rendezvous Navigation 3-1
P21 Ground Track Determination 3-3
P22 Orbital Navigation 3-4
P23 Optics Calibration 3-6
P23 Cislunar Midcourse Nav. Meas. 3-7
P27 CMC Update 3-9

Basic Date October 6, 1969
Changed
CSM 108

4. PRETHRUST (P30's)
P30 External ΔV 4-1
P31 General Lambert Prethrust 4-1
P32 CSI Prethrust 4-2
P33 CDH Prethrust 4-3
P34 TPI Prethrust (P74 LM) 4-4
P35 TPM Prethrust (P75 LM) 4-6
P37 Return to Earth Program (CORR CONT) 4-7
P37 Return to Earth Program (LONG CONT) 4-9
Obtain Entry REFSMMAT (NO COMM) 4-11/12
P38 SOR Targeting (P78 LM) 4-13
P39 Stable Orbit Mid (P79 LM) 4-14

5. THRUSTING (P40's) 5-1
P40 SPS Thrusting 5-1
P41 RCS Thrusting 5-7
P47 Thrust Monitor 5-11/12

6. ALIGNMENTS (P50's) 6-1
P51 IMU Orientation 6-1
P52 IMU Realign 6-2
P53 Backup IMU Orient Determination 6-4
P54 Backup IMU Realign 6-5

7. TARGETING (P70's) 7-1
P72 LM CSI Targeting 7-1
P73 LM CDH Targeting 7-3
P76 Target ΔV 7-5/6

8. EXTENDED VERBS 8-1
V35 DSKY Condition Light Test 8-1
V41 N91 Coarse Align OCDU's 8-1
V41 N20 Coarse Align ICDU's 8-2
V42 Gyro Torquing 8-2
V48 DAP Data Load & Activate Procedure 8-3
V49 Crew Defined Maneuver 8-4
V55 CMC Time Update 8-4
V64 Hi Gain Antenna Pointing 8-4
V67 W-Matrix Error Display 8-5
V74 CMC Downlink 8-5
V79 DAP PTC/ORB RATE 8-5
V82 Orbit Parameter Display 8-5

V83 Rndz Parameter Display #1 8-6
V85 Rndz Parameter Display #2 8-6
V87 Set VHF RNG Flg 8-6
V89 Rendezvous Final Attitude 8-7
V90 Out-of-Plane Display 8-7
V91 Compute Banksum 8-8
V93 Enable W-Matrix Initialization 8-8

9. SCS GENERAL 9-1
SCS Power Up 9-1
SCS Power Down 9-1
GDC Alignment to IMU Gimbal Angles 9-2
SCS Attitude Reference Comparison 9-2
Backup GDC Alignment 9-2
Backup GDC & IMU Alignment 9-3
In-plane GDC Alignment 9-4
PGNS ORDEAL Initialization 9-4
SCS ORDEAL Initialization 9-5
COAS LOS Determination 9-5
Passive Thermal Control (G&N) 9-6
Passive Thermal Control (SCS) 9-8
CMC/LGC Clock SYNC/TEPHEM Update 9-9
Docked IMU Align 9-10

10. SYSTEM MANAGEMENT 10-1
PROPULSION SYSTEM 10-1
1 SPS MONITORING CK 10-1
2 SM RCS MONITORING CK 10-1
3 CM RCS MONITORING CK 10-1
EPS SYSTEM 10-2
1 CRYO PRESS QTY CK 10-2
2 FC POWER PLANT CK 10-2
3 DC VOLT AMP CK 10-2
4 AC VOLT CK 10-2
5 BATTERY CHARGING 10-2
6 FC POWER PLANT PURGING 10-3
7 H2/02 QTY BAL CORR 10-3
8 FC SHUTDOWN 10-3
9 FC SWITCHING 10-4
10 INVERTER CHANGEOVER 10-4
11 CRYO 02 & H2 MAN FAN OPN 10-4

ECS SYSTEM		10-4
1	ECS MONITORING CK	10-4
2	ECS PER REDUNDANT COMP CK	10-5
3	CO2 ABSORBER FILTER REPLACEMENT	10-6
4	DEBRIS SCREEN CHECK	10-7
5	CM O2 SUPPLY REFILL	10-7
6	DOFFING PGA	10-7
7	DONNING PGA	10-7
8	PARTIAL SUIT CKLIST	10-8
9	URINE DUMP MODES	10-8
10	CABIN PRESSURIZATION	10-9
11	SUIT CKT INTEGRITY CK	10-10
12	PGA INTEGRITY CK	10-10
13	CM PRESSURE DUMP	10-11
14	SUIT CKT H2 PURGE	10-12
15	CABIN COLD SOAK	10-12
16	PRI EVAP OPN	10-13
17	SEC EVAP OPN	10-13
18	POTABLE WATER CHLORIN	10-13
19	WASTE WATER TANK DRAIN	10-14
20	SIDE HATCH URINE/WATER DUMP	10-14
21	WATER COLLECTION	10-14
22	WATER/GAS SEPARATOR SERVICING	10-14
23	PRE LOI SEC GLY LOOP CHECK	10-15
24	CONTAMINATION CONTROL	10-15
C&WS OPERATIONAL CHECKS		10-15
TELECOMM PROCEDURES		10-16
1	HI-GAIN ANT OPN	10-16
2	BLACK & WHITE TV CAMERA OPN	10-19
	HGA Scan Limit Graph	10-17
	Antenna Positions	10-18
2A	COLOR TV CAMERA OPN	10-19
3	VHF RANGING	10-20
4	RNDZ XPNDR ACT & SELF TEST	10-21
5	COMM MODES	10-21
	RCS ENGINE, VENT, & RAD LOC	10-25
	SYSTEM TEST CHART	10-26

11. LM INTERFACE 11-1
1 IVT to LM for first entry 11-1
2 IVT to LM for second entry 11-1
3 Tunnel Hatch Removal 11-2
4 Probe Removal (CM side) 11-3
5 Drogue Removal 11-4
6 Crew Transfer to LM 11-4
6A Crew Transfer to CSM 11-4
7 Remove LM Umbilicals (FINAL) 11-4
8 Install Drogue 11-4
9 Install Probe 11-5
10 Preload Probe 11-5
11 Hatch Installation 11-5
12 Hatch Integrity Check 11-6
13 Malfunction List 11-6
CSM Docking 11-9
LM JETTISON 11-10

12. CONTINGENCY EVA 12-1

13. LOI ABORT 13-1

14. FLIGHT EMERGENCY 14-1
Fire/Smoke In CM (CREW SUITED) 14-1
Fire/Smoke In CM (CREW UNSUITED) 14-2
C&W/Malfunction Indicators 14-4
Emergency Power Down 14-7
Bus Loss Reconfiguration 14-8
Loss of Two Fuel Cells 14-13
Non-Dioded/Non-Switchable Loads 14-14

15. CREW LOG

Basic Date _____
Changed _____