CAP COMM

APOLLO 8

CMP CHECKLIST

PART NO.	S/N
SKB 32100028-201	1004

				CDR	CMP	LMP
00:00	72.2° US / CYI	90.2° US	108.2° US / TASC			

POST INSERTION CONFIG
SM/CM RCS/C&W CK

REMOVE HELMET & GLOVES

CDR	LMP
ECS POST INSERT CK	ECS POST INSERT CK
GDC ALIGN	EPS PER MON ECS MON CK SPS PER MON PUGS TEST ECS REDUND COMP CK FC PURGE CK
MOUNT ORDEAL	

00:30 — PRE (90.2°), PRE (108.2°)

JETT OPTICS COVER

INSTALL COAS
COAS HORIZ CK

CRO (72.2°), CRO (90.2°), CRO (108.2°)

OPTICS CK
&
IMU REALIGN
P52

01:00 — HSK (72.2°), GWM (108.2°)

72.2° — 90.2° — 108.2°

HAW (90.2°), HAW (108.2°)

01:30 — US (90.2°), US (108.2°)

CMP INSERT CKS

G&C CHECKLIST

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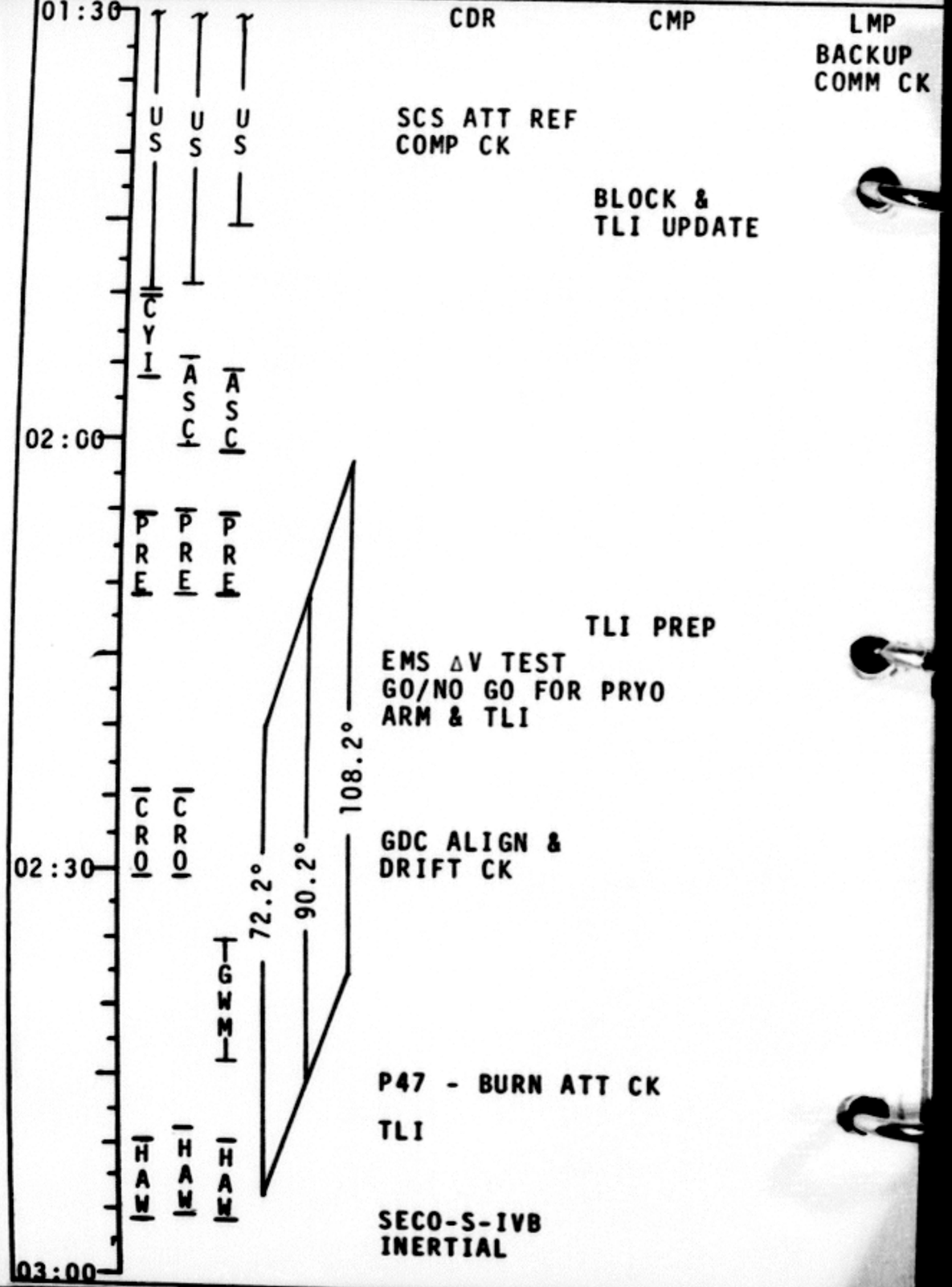

POST INSERTION CHECKLIST

1

SM RCS HTRS (4) - PRIM
CM RCS PRPLNT (both) - OFF, tb-bp
C/W FUNCTION - NORMAL
HATCH GEAR BOX - LATCH (verify)
ACTR HNDL SELECTOR - neutral

2

SM RCS ck
SM RCS SEC PRPLNT TB (4) - bp
He 1&2 TB (8) - GRAY
PRIM PRPLNT TB (4) - GRAY
RCS IND SW - SM A, B, C, D
PKG TEMP - 105°-195°F
He PRESS - Record_____
MANF PRESS - 178-192 psig
He TK TEMP - Record_____
PRPLNT QTY - Record_____

3

CM RCS ck
CM RCS PRPLNT TB (both) - bp
RCS IND SW - CM 1, 2
He TEMP - 60-90°F
He PRESS - 4000-4450 psia
FUEL PRESS - 25-~~60~~ 225 psia
OXID PRESS - 25-~~60~~ 225 psia

4

C&WS OPER ck
C/W LAMP TEST - 1 (hold)
M/A Pnl 1 - ON
LH C/W lts (16) - ON
C/W LAMP TEST - 2 (hold)
M/A Pnl 1 - OFF
LH C/W lts (16) - OFF
M/A Pnl 3 - ON
RH C/W lts (23) - ON
C/W LAMP TEST - OFF (lts OFF)
C/W CSM - CM
CM RCS lt (both) - ON
M/A tone & lts (3) - ON, RESET
M/A tone & lts (3) - OFF
C/W CSM - CSM
CM RCS lts (both) - OFF

Basic Date — Nov. 6, 1968
Changed — Dec. 13, 1968

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CMP INSERT CKS

CMP to LEB
5 PYRO A&B SEO A&B cb(both)-open
SECS LOGIC (both) - OFF (CDR)
MAIN REG B vlv - CLOSE
EMER CAB PRESS vlv - 1
PUSH TO TEST - PUSH (O2 FLOW INC)
MAIN REG B vlv -OPEN
MAIN REG A vlv -CLOSE
EMER CAB PRESS vlv - 2
PUSH TO TEST - PUSH (O2 FLOW INC)
MAIN REG A vlv - OPEN
EMER CAB PRESS vlv - BOTH (OFF if suited)
6 SUIT CKT RET vlv - OPEN (pulled)
REMOVE HELMETS & GLOVES

7 SEC RAD LEAK CK
Notify LMP when ready to commence
SEC GLY to RAD vlv - NORMAL
Allow 30 sec for LMP to monitor accum qty
SEC GLY to RAD vlv - BYPASS

8 ECS POST INSERT CONFIG (CDR & LMP)

9 DRINKING WATER SUP vlv - ON (CCW)

SYS VERIF & MONITORING

1 UNSTOW CAMERAS
B3 - 16 mm DAC, 18 mm lens, Rt angle mirror,
16 mm C-EX mag, Pwr cable,
70 mm camera, 80 mm lens, 70 mm C-mag
R13- Spot

2 OPTICS DUST COVER JETT
Install Eyepieces
OPTICS ZERO - OFF
G/N OPT PWR - ON
OPT MODE - MAN
OPT COUPLING CONT - DIRECT
OPT SPEED CONT - HI
OHC - MAX RIGHT - OBS EJECT thru eyepiece

3 IMU REFSMMAT REALIGN ck (P52), pg G-56
X Torquing angle _____
G/N PWR OPTICS - OFF

Basic Date Nov. 6, 1968
Changed Dec. 15, 1968

Basic Date Nov. 6, 1968
Changed Nov. 27, 1968

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G&C CHECKLIST TABLE OF CONTENTS

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STAR LIST

STAR NAME (Numerical)		STAR NAME (Alphabetical)	
00	Planet	Acamar	6
1	Alpheratz	Achernar	4
2	Diphda	Acrux	25
3	Navi	Aldebaran	11
4	Achernar	Alkaid	27
5	Polaris	Alphard	21
6	Acamar	Alphecca	32
7	Menkar	Alpheratz	1
10	Mirfak	Altair	40
11	Aldebaran	Antares	33
12	Rigel	Arcturus	31
13	Capella	Atria	34
14	Canopus	Canopus	14
15	Sirius	Capella	13
16	Procyon	Dabih	41
17	Regor	Deneb	43
20	Dnoces	Denebola	23
21	Alphard	Dephda	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

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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
*44 Set surface flag
*45 Reset surface flag
*46 Activate DAP
*47 Set LM State Vector into CSM State Vector
48 Load DAP (R03)
49 Start Crew Defined MNVR(R62)
50 Please Perform

51 Please Mark
*52 Marked on offset landing site
53 Please Mark alternate LOS
54 Start REND backup sighting mark (R23)
55 Increment CMC Time (Decimal)
*56 Terminate Tracking (P20)
57 Start REND sighting mark (R21)
*58 Reset Stick FLAG
59 Please Calibrate
*60 Set N17 = N20
*61 Display DAP att error
*62 Display total att error (N22-N20)
*63 Display total astro att error (N17-N20)
64 Start S-band ant routine (R05)
*65 Verify Prelaunch Align Optics (CSM)
*66 Set CSM State Vector into LM State Vector
67 W-Matrix RMS Error Display
*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
*77 Reset preferred att flag
*78 Update prelaunch azimuth
79 Start lunar LMK selection (R35)
*80 Update LM State Vector
*81 Update CSM State Vector
82 Start Orbit Param Disp (R30)
83 Start REND Param Display (R31)
85 Start REND Param Display No.2 (R34)
*86 Reject REND backup sighting mark
*87 Set VHF range flag
*88 Reset VHF range flag
89 Start REND Final ATT Routine (R63)

90	Request REND out of plane display (R36)
91	Compute Banksum
*92	Start IMU performance test (P07)
*93	Enable REND W matrix initialization
*94	Enable CISLUNAR Tracking recycle
*96	Terminate integration and go to P00
97	SPS Thrust Fail (R40)
99	Enable engine ignition

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

NOUN LIST (Decimal)

01	Specify Machine Address (Fract) (R1,R2,R3)	.XXXXX
02	Specify Machine Address (Whole) (R1,R2,R3)	
03	Specify Machine Address (can be R1,R2,R3)	.01°
05	Angular Error/Diff	.01°
06	Option Code (R1 & R2)	OCTAL
07	FLAGWORD operator,ECADR,BIT ID,	Action
08	Alarm Data	OCTAL
09	Alarm Codes	OCTAL
10	Channel to be Specified (R1)	OCTAL
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)	
31	Time of landing site	hrs,min,.01sec
32	Time from Perigee	hrs,min,.01sec
33	Time of Ignition (GETI)	hrs,min,.01sec
34	Time of Event	hrs,min,.01sec
35	Time from Event	hrs,min,.01sec
36	Time of CMC Clock	hrs,min,.01sec
37	GETI-TPI	hrs,min,.01sec
38	State Vector Time	hrs,min,.01sec
39	Δ Time of Transfer	hrs,min,.01sec

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40	TF GETI/TFC	min-sec
	VG	.1 FPS
	ΔV (Accumulated)	.1 FPS
41	Target	Azimuth .01°
		Elevation .001°
		Ident 0000X
42	Apogee Alt (HA)	.1 NM
	Perigee Alt (HP)	.1 NM
	ΔV (Required)	.1 FPS
43	Lat	.01°
		(+ North)
	Long	.01°
		(+ East)
	Alt	.1 NM
44	Apogee Alt (HA)	.1 NM
	Perigee Alt (HP)(N50)	.1 NM
	TFF	min-sec
45	Marks	XXBXX
	TF GETI of next burn	min-sec
	MGA	.01°
46	DAP Config (R1&R2)	OCTAL
47	CSM weight	LBS
	LM Weight	LBS
48	Pitch Trim	.01°
	Yaw Trim	.01°
49	ΔR	.1 NM
	ΔV	.1 FPS
	SOURCE CODE	0000X.
50	ΔR (miss distance)	.1 NM
	PERIGEE (HP)	.1 NM
	TFF	min-sec
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°

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55	Perigee code	CODE
	R2 E(ELEV ANGLE)	.01°
	R3 CENTANG (passive veh)	.01°
57	ΔR offset (SOR)	.1 NM
	(+ indicated behind LM)	
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 Above Pad Radius	.1 NM
63	RTGO from 0.05 G	.1 NM
	To Splash	
	VIO, Predicted Iner Vel	FPS
	TFE, time from .05G	min-sec
64	Drag Acceleration	.01 G
	VI, Inertial Velocity	FPS
	RTOGO to Target	.1 NM
65	Sampled CMC Time	hrs,min,.01 sec
	(fetched in interrupt)	
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)

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CMP INSERT CKS

68	Beta, CMD Bank Angle		.01°
	VI, Inertial Vel.		FPS
	H Dot, Alt Rate		FPS
69	Beta		.01°
	DL		.01 G
	VL		FPS
70	Star Code(before mark)		OCTAL
	LMK Data		OCTAL
	Horiz data		OCTAL
71	Star code (after mark)		OCTAL
	LMK Data		OCTAL
	Horiz data		OCTAL
72	Δ ang		.01°
	Δ alt		.1 NM
	Search option		
81	ΔVX,Y,Z (lcl vert)		.1 FPS
83	ΔVX,Y,Z (Body Control Axis)		.1 FPS
84	ΔVX,Y,Z (Other Vehicle)		.1 FPS
85	VGX,Y,Z (Body Control Axis)		.1 FPS
87	Opt Calib Data - Shaft (R1)		.01°
	Trunnion(R2)		.001°
88	Planet	X	.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°

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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	.01 NM
	VEL ERR	.1 FPS
	OPTION Code	000X.

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V05 N09 ALARM CODES

00110 Mark reject has been entered but ignored
00112 Mark reject with no marks being accepted
00113 No inbits (chan 16)
00114 More marks made than desired
00115 V41 N91 keyed with OPTICS MODE not in CMC
00116 Optics switch altered before 15 sec zero time elapsed
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)
00120 Optics torque has been requested but optics have not been zeroed since last FRESH START or RESTART
(m)00121 In 0.05 sec following mark, an ICDU changed by more than 0.033°
00122 Marking not called for
00124 P17(77) TPI search unsuccessful
(m)00205 PIPA saturated
00206 The IMU zero routine has been entered with both the GMBL LOCK lt and NO ATT lt on
(m)00207 ISS turn-on request not present for 90 sec
(m)00210 The IMU is not operating
(m)00211 Coarse align error
(m)00212 PIPA fail, but PIPA is not being used
(m)00213 IMU not operating with turn-on request
00214 Program using IMU when turned OFF

(m)00217 IMU coarse align or pulse torque difficulty has occurred
00220 IMU orientation unknown
00401 Desired middle gimbal angle is excessive
00404 Target out of view (90 deg test)
00405 Acceptable star pair is not available
00406 Rend navigation not operating
00407 Target out of view (50° test)
00421 W-matrix overflow
00605 Number of iterations exceeds loop maximum
00611 No TIG for given ELEV angle
00612 State vector in wrong sphere of influence
00613 Reentry angle out of limits
00777 ISS warning caused by PIPA fail
01102 CMC self test error
*01103 Unused CCS branch executed
**01104 Delay routine busy
(m)01105 Downlink too fast
(m)01106 Uplink too fast
01107 Phase table failure assume erasable memory is destroyed
**01201 Executive overflow - no vac. area
**01202 Executive overflow - no core sets
**01203 Waitlist overflow - too many tasks
*01206 Second job attempts to go to sleep via keyboard and display program
**01207 No vac area for marks
*01210 Second attempt is made to stall
**01211 Illegal interrupt of extended verb
*01301 Arcsin or arccos input is greater than one
*01302 SQRT called with negative argument
(m)01407 VG increasing
01426 IMU unsatisfactory
01427 IMU reversed

*01501 Keyboard and display alarm during internal use (NVSUB)
*01502 Illegal flashing display
01520 V37 request not permitted at this time
01600 Overflow in drift test
01601 Bad IMU torque abort
01602 Bad optics during verification
01703 Insufficient time for integration TIG slipped
03777 ISS warning caused by ICDU fail
04777 ISS warning caused by ICDU & PIPA fail
07777 ISS warning caused by IMU fail
10777 ISS warning caused by IMU & PIPA fail
13777 ISS warning caused by IMU & ICDU fail
14777 ISS warning caused by IMU,ICDU & PIPA fail

(m) - Malf procedure indicated
* - Generates Restart, F37
** - Restart and program continues (i.e. attempted recovery)

V50 N25 CHECKLIST CODES

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

V04 N06 OPTION CODES

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

CMP INSERT CKS

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 20 sec

2 V37E XXE
*If CMC Failed: *
* G/N IMU PWR - on(up) *
* Wait 90 sec *
* IMU CAGE - on(up) 5 sec, then off*

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

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Block Changed

IMU POWER DOWN PROCEDURE

CMC MODE - FREE

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

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CMP INSERT CKS

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

1
V37E 17E or V37E 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)
(Do not key V82 during this display)
R3=SEARCH OPT 00001<180°
00002>180°
(change GETI TPI) V32E To 1
(change Search opt) V23E
PRO
F 05 09 00124 alarm code
*V32E, RSET To 1 *

3 F 06 58 HP,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

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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°)
If only F 50 - KEY RLSE
(AUTO) SC CONT - CMC
CMC MODE - AUTO
PRO
06 18 RPY (.01) To 1 (when MNVR complete)
(MAN) SC CONT - SCS
PRO To 1
or V62E
RHC - MNVR To 1

When attitude OK:
CMC MODE - AUTO
ENTR
OPTIC ZERO - OFF

*POSS prog alarm *
*Key V5N9E 00407 (TA>50°) *
*V16N 22E *
GMBL ANGLES RPY (.01°)
*or V16N 92E *
OPTICS SHAFT,TRUN (.01°,.001°)
*(AUTO) SCS 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)

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POSS F 06 49 ΔR,ΔV, source code
* (.1nm,.1fps,00001) *
*(REJECT) V32E *
*(ACCEPT) PRO *
Drive Trunnion to <5°
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,00001) *
*(REJECT) V32E *
*(ACCEPT) PRO *
PRO (return to Program in process)
(To Terminate P20 - V56E)

P21 GROUND TRACK DETERMINATION

Note: Do not key V82 during step 1 or 2
CMC - on (req)

1 V37E 21E
F 04 06 00002, Specify Vehicle
00001, CSM
00002, LM
PRO

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

3 F 06 43 LAT,LONG,ALT (.01°,.01°,.1nm)
(RECYCLE) V32E to 2 (Increment GET 10 min)
(EXIT) PRO

4 F 37 XXE above 10,000 nm Key V16 N02E, 1107E
ALT nm = R 1(XXXXX.) x 17.7

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LANDMARK LIGHTING EVALUATION (CMP)

1 ATTACH SEQ. CAM ADAPTER TO SXT
1/125, 6 FPS

2 REVIEW OPB AND LC

3 NOTE TRACKING DATA
ACQ IP-I _____
LMK LAT _____
LMK LONG/2 _____

4 CONFIRM ORBRATE ATTITUDE (LMP)
000, 355, 000

5 SET OPTICS MAN AT IP-I - 5 MIN
SHAFT 0
TRUNNION 0

6 START SEQ CAM AT I P-I - 2 MIN

7 NOTE GET I P-I _____

8 DETERMINE GET I P-II (LMP)

9 EVALUATE BOULDER VISIBILITY

10 NOTE GET I P-II _____

11 DETERMINE GET LMK (LMP)

12 EVALUATE SCENE AT I P-II AND EVERY 20 SEC
AMOUNT STD CRATER VISIBLE
BEST STD CRATER MARKING POINT
BEST RECOGNITION PATTERNS
BOULDER OBSERVATIONS

13 MONITOR CMP DESCRIPTION (LMP)

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P23

CMP INSERT CKS

14 EVALUATE SCENE AT EACH LMK OR EVERY 20 SEC
MINIMUM CRATER SIZE FOR MARKING
AMOUNT STD CRATER VISIBLE
BEST STD CRATER MARKING POINT
BEST RECOGNITION PATTERNS

15 MONITOR CMP DESCRIPTION (LMP)

16 EVALUATE SCENE IN EARTHSHINE EVERY 20 SEC
DARK ADAPTATION
TYPES OF FEATURES VISIBLE
MINIMUM CRATER SIZE FOR MARKING
CHANGE WITH EARTH-ANGLE
BEST RECOGNITION PATTERNS

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P22

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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)
OPTICS 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
A=1(known), 2(unknown)
B=INDEX OF OFFSET designator
C=not used
DE=LMK ID
IF A=2
OPT MODE - MAN
PRO to 5
or IF A=1 & DE≠00
PRO to 4 (To 5 if OPTICS - MAN)
or IF A=1 & DE=00
PRO to 3

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

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

5 F 51 MARK REQUEST
MARK (wait 10 sec between MARKS)
After sufficient MARKS:
*After 5 MARKS: *
F 50 25 00016 TERM MARKS
PRO

6 F 05 71 R2 ABCDE LMK DATA
Load lmk code (if nec)
A=1 if KNOWN LMK
A=2 if UNKNOWN LMK
B=INDEX OF OFFSET DESIGNATOR
(If only 1 mark made, insure B=0)
C=Not used in P22
DE=LMK ID no.
PRO - if A=2 (or A is 1 & DE ≠ 0) to 9

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

8 F 06 49 ΔR,ΔV (ORB PARA) (.1nm,.1fps)
(REJECT CYCLE) V32E to 2
(ACCEPT) PRO

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

10 F 37 XXE
OPT ZERO - ZERO

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Changed —

P22 - ORBITAL NAVIGATION
(LDG SITE - AUTO OPTICS)
CMC - on (req)
ISS - on & aligned (req)
SCS - on (req)
ORB RATE BALL (des)
G/N PWR OPTICS - on (verify)
OPTICS COUPLING - RESOLVED
SPEED - MED
OPT ZERO - ZERO (verify)
OPT MODE - CMC
16mm camera - installed

1 V37E 22E
F 06 45 R3=Max MGA with X axis in-plane
If R3 > 60°, Go To P52

MNVR to SIGHTING ATTITUDE
Roll to keep shaft axis > 10° from
plane defined by X axis & LOS to LMK
PRO

2 F 05 70 R2=LMK DATA
Load 10001
OPT ZERO - OFF
PRO

3 06 92 AUTO OPTICS SHAFT, TRUN (.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

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P23

4	F 51	REQUEST MARK MARK (wait 10 sec between MARKS) After sufficient MARKS: *After 5 MARKS: * *F 50 25 00016 TERM MARKS * PRO
5	F 05 71	R2=10001 LMK DATA PRO
6	F 06 49	ΔR,ΔV ORB PARA (.1nm,.1fps) Hold 1 min PRO
7	F 06 89	LAT,LONG/2,ALT (.001°,.001°,.01nm) Compare with map V34E
8	F 37	XXE OPT ZERO - ZERO

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P22 ORBITAL NAVIGATION
(UNKN CONT PT. - MAN OPTICS)

CMC - on (req)
ISS - on & aligned (req)
SCS - on (req)
ORB RATE BALL (des)
BMAG MODE (3) - RATE 2
G/N PWR OPTICS - on (verify)
OPT ZERO - ZERO (verify)
OPT MODE - MAN
16mm camera - installed
RCDR - LBR/RCD/FWD (Verify)

1		V37E 22E
	F 06 45	R3=Max MGA with X axis in-plane *If R3 > 60°, Go to P52*

MNVR to SIGHTING ATTITUDE
Roll to keep shaft axis > 10° from plane defined by X axis & LOS to LMK

PRO

2	F 05 70	R2=LMK DATA LOAD 20000 Establish proper pitch rate OPT ZERO - OFF PRO
3	F 51	REQUEST MARK V16 N91E
4	F 16 91	SHAFT,TRUN (.01°,.001°) MARK (wait 10 sec between MARKS) After sufficient MARKS: *After 5 MARKS: * *F 50 25 00016 TERM MARKS* KEY RLSE PRO

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5	F 05 71	R2 20000 LMK DATA PRO (If only 1 MARK to 6)
6	F 06 49	ΔR,ΔV ORB PARA (.1nm,.1fps) PRO
7	F 06 89	LAT,LONG/2,ALT (.001°,.001°,.01nm) Record for future use (RECYCLE) V32E to 2 (EXIT) V34E
8	F 37	XXE

OPT ZERO - ZERO

P22 ORBITAL NAVIGATION
(KN CONT PT. - AUTO OPTICS)

CMC - on (req)
ISS - on & aligned (req)
SCS - on (req)
ORB RATE BALL (des)
BMAG MODE (3) - RATE 3
G/N PWR OPTICS - on (verify)
OPTICS COUPLING - RESOLVED
SPEED - MED
OPT ZERO - ZERO (verify)
OPT MODE - CMC
RCDR - LBR/RCD/FWD (Verify)

1	F 06 45	V37E 22E R3=Max MGA with X axis in-plane *If R3 >60°, Go to P52* MNVR to SIGHTING ATTITUDE Roll to keep shaft axis > 10° from plane defined by X axis & LOS to LMK PRO
2	F 05 70	R2=LMK DATA LOAD 10000 PRO
3	F 06 89	LAT,LONG/2,ALT (.001°,.001°,.01nm) Load lmk coords OPT ZERO - OFF PRO
4	06 92	AUTO OPTICS SHAFT,TRUN (.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

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5	F 51	REQUEST MARK MARK (wait 10 sec between MARKS) After sufficient MARKS: *After 5 MARKS: * *F 50 25 00016 TERM MARKS * PRO	
6	F 05 71	R2=10000 LMK DATA PRO	
7	F 06 89	LAT,LONG/2,ALT Verify data PRO	(.001°,.001°,.01nm)
8	F 06 49	ΔR,ΔV ORB PARA PRO	(.1nm,.1fps)
9	F 06 89	LAT,LONG/2,ALT Rcrd for future use (RECYCLE) V32E to 2 (EXIT) V34E	(.001°,.001°,.01nm)
10	F 37	XXE OPT ZERO - ZERO	

P23 OPTICS CALIBRATION

CMC - on
OPT ZERO - ZERO (verify)
OPT MODE - MAN

1	F 05 70	V37E 23E (IMU NOT ALIGNED - To 3) STAR ID(ABCDE)/LMK ID/HOR ID Insure R1 DE≠00 and R3≠00000 PRO	
2	F 50 25	00202 MNVR/CALIB REQUEST ENTR	
3	F 59	PERFORM OPTICS CALIB OPT MODE - MAN (verify) OPTICS COUPLING - DIRECT SPEED - LOW OPT ZERO - OFF SUPERIMPOSE LLOS TO SLOS MARK	
4	F 06 87	R2 TRUNNION ANGLE BIAS (repeat until 2 measurements agree within .003°) (ACCEPT) PRO (REJECT) V32E to 3	(.001°)
5	F 51	V37E XXE OPT ZERO - ZERO	

CMP INSERT CKS

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CMP INSERT CKS

P23 - CISLUNAR MIDCOURSE NAV MEASUREMENT
(AUTO MANEUVER FIRST)

If alt above earth or moon <432 nm, do not mark on secondary body.
CMC - on
SCS - on
ISS - on & aligned
G/N PWR OPTICS - on (30 min prior)
OPT ZERO - ZERO (verify)
OPT MODE - CMC
RCDR - LBR/RCD/FWD (Verify)

1 **V37E 23E**

F 05 70 **STAR ID/LMK ID/HOR ID (OCTAL)**
Load codes

STAR/ENH	STAR/LNH	STAR/EL
000DE	000DE	000DE
00000	00000	00100
00110	00210	00000

STAR/EFH	STAR/LFH	STAR/LL
000DE	000DE	000DE
00000	00000	002XX
00120	00220	00000

(STAR/LMK) PRO to 2 (XX≠00 to 3)
(STAR/HOR) PRO to 3

2 F 06 89 **LAT,LONG/2,ALT(LMK) (.001°,.001°,.01nm)**
Load lmk coords
PRO

3 F 50 25 **00202 MNVR REQUEST**
PRO

4 F 50 18 **REQUEST MNVR TO FDAI RPY ANGLES (.01°)**
(AUTO) SC CONT - CMC
CMC MODE - AUTO
PRO
(BYPASS MNVR/TRIM) - ENTR to 7
(If no cal go to 6)

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5 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
AUTO MNVR complete return to 4
MAN MNVR - V62E
RHC - NULL ERROR NEEDLES Return to 4

6 F 59 REQUEST OPTICS CALIB
OPT MODE - CMC (verify)
OPT ZERO - OFF
ENTR (Until step 10,auto mnvr repeat - V94E to 4)
*F 05 09 00404 (TA>90°) *
*V94E to 4 (AUTO MNVR) *
* or MAN MNVR - PRO to 7 *

7 06 92 AUTO OPTICS SHAFT,TRUN (.01°,.001°)
*PROG ALARM *
*V5N9E - 00407 (TA >50°) *
*V94E to 4 (AUTO MNVR) *
*or MAN MNVR - KEY RLSE to 7 *

MNVR TO POSITION LMK/HOR IN FOV
OPT MODE - MAN

8 F 51 REQUEST MARK
OPTICS COUPLING - RESOLVED
SPEED - LOW
SUPERIMPOSE STAR ON LMK/HOR
MARK

9 F 50 25 00016 TERMINATE MARKS
(MARK REJECT) To 8
(TERM) PRO

10 F 05 71 STAR ID/LMK ID/HOR ID (OCTAL)
Verify codes
(STAR/LMK) PRO to 11 (LMK XX≠00 to 12)
(STAR/HOR) PRO to 12

11 F 06 89 LAT,LONG/2,ALT(LMK) (.001°,.001°,.01nm)
Verify coords
PRO

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P51-55

12 F 06 49 ΔR,ΔV (SV Para) (.1nm,.1fps)
Record data (R1&R2)
Wait 30 sec
V1 N1E
2754E
Record data (R1-Trun in octal)
Wait 30 sec
KEY RLSE
N38E (hr,min,.01sec)
Record MARK TIME
KEY RLSE
(REJECT i.e. ΔR,ΔV>0050.0) V37E 23E to 1
(UPDATE) PRO

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

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P23 - CISLUNAR MIDCOURSE NAV MEASUREMENT
(AUTO OPTICS FIRST)

If alt above earth or moon <432nm do not mark on secondary body.
CMC - on
SCS - on
ISS - on & aligned
G/N PWR OPTICS - on (30 min prior)
OPT ZERO - ZERO (verify)
OPT MODE - CMC
RCDR - LBR/RCD/FWD (Verify)

1 V37E 23E
F 05 70 STAR ID/LMK ID/HOR ID (OCTAL)
Load codes

STAR/ENH	STAR/LNH	STAR/EL
000DE	000DE	000DE
00000	00000	00100
00110	00210	00000

STAR/EFH	STAR/LFH	STAR/LL
000DE	000DE	000DE
00000	00000	002XX
00120	00220	00000

(STAR/LMK) PRO to 2 (XX≠00 to 3)
(STAR/HOR) PRO to 3

2 F 06 89 LAT,LONG/2,ALT(LMK) (.001°,.001°,.01nm)
Load lmk coords
PRO

3 F 50 25 00202 MNVR/CALIB REQUEST
ENTR

4 F 59 REQUEST OPTICS CALIB
OPT MODE - CMC (verify)
OPT ZERO - OFF
ENTR
F 05 09 00404 (TA>90°)
*V94E to 6 (AUTO MNVR) *
or MAN MNVR - PRO to 5

CMP INSERT CKS

```
5     06 92   AUTO OPTICS SHAFT,TRUN      (.01°,.001°)
                        *PROG ALARM                    *
                        *V5N9E-00407(TA>50°)           *
                        *V94E to 6 (AUTO MNVR)         *
                        *or MAN MNVR - KEY RLSE to 5   *
              V94E

6   F 50 18   REQUEST MNVR TO FDAI RPY ANGLES  (.01°)
              V62E
        (AUTO)     SC CONT - CMC
                   CMC MODE - AUTO
              PRO
        (MAN MNVR)SC CONT - SCS
                  or CMC MODE - HOLD or FREE to 6
                     (For recalc - PRO as desired)
        (BYPASS MNVR/TRIM) - ENTR - To 8

7     06 18   AUTO MNVR TO FDAI RPY
              AUTO MNVR complete - To 6
            or RHC - NULL ERROR NEEDLES - To 6  (.01°)

8     06 92   AUTO OPTICS SHAFT,TRUN      (.01°,.001°)
              MNVR TO POSITION LMK/HOR IN FOV
                   OPT MODE - MAN

9   F 51      REQUEST MARK
        (MNVR)     V94E - To 6
        (MARK)     OPTICS COUPLING - DIRECT
                          SPEED - LOW
                   SUPERIMPOSE STAR ON LMK/HOR
                   MARK

10  F 50 25   00016 TERMINATE MARKS
        (MARK REJECT) To 9
        (TERM)        PRO

11  F 05 71   STAR ID/LMK ID/HOR ID            (OCTAL)
              Verify codes
        (STAR/LMK)  PRO - To 12 (LMK XX≠00 to 13)
        (STAR/HOR)  PRO - To 13
```

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```
12  F 06 89   LAT,LONG/2,ALT(LMK) (.001°,.001°,.01nm)
              Verify coords
              PRO

13  F 06 49   ΔR,ΔV (SV Para)                 (.1nm,.1fps)
              Record data (R1&R2)
              Wait 30 sec
              V1N 1E
                2754E
              Record data (R1-Trun in octal)
              Wait 30 sec
              KEY RLSE
        (REJECT i.e. ΔR,ΔV>0050.0)V37E 23E to 1
        (UPDATE)  PRO

14  F 37      23E to 1
            or 00E

              OPT ZERO - ZERO
```

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CMP TNSFRT CKS

P23 CISLUNAR MIDCOURSE NAV MEASUREMENT (IMU NOT AVAIL)

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

CMC - on
SCS - on
G/N PWR OPTICS-in(30min prior)
OPT ZERO - ZERO (verify)
OPT MODE - MAN
RCDR-LBR/RCD/FWD(verify)

1 F 59 V37E 23E
REQUEST OPTICS CALIB
OPTICS ZERO - OFF
ENTR

2 F 51 SIGHTING MARK ROUTINE

a. MNVR S/C to acquire LMK in center of Sct & LLOS

b. Tel Trun - 25° (To increase star acquisition potential) Note:(1) Only shaft control available (2) LMK will now appear at 0° position on R line

c. Acquire star in SCT by rotating shaft. Line up R line on star read trun angle on mech. counter.

d. SCT MODE - Slave to SXT. Set trun to angle observed in SCT. This will roughly align SLOS and SCT on star. Star will also move to 0° MSCT. Now star (through SLOS) and landmark (through LLOS) should be seen through SXT.

P22

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e. Tracking procedures - Position S/C to put vertical lines of sextant recticle perpendicular to horizon (or centered on LMK). Use min impulse control. Use optics control (resolved and low) to place star on horizon (or center if LMK) and in middle of double lines.

MARK

3 F 50 25 R1 00016 Terminate Marks
(MARK REJECT) To 2
(TERM) PRO

4 05 71 STAR ID/LMK ID/HOR ID (Octal)
Verify Codes
(STAR/LMK) PRO To 5 (LMK XX≠00 to 6)
(STAR/HOR) PRO To 6

5 F 06 89 Lat, Long/2, Alt(LMK) (.001°,.001°,.01nm)
Verify Coords
PRO

F 06 49 ΔV, ΔV (SV Para) (.1nm,.1fps)
Record data (R1 & R2)
Wait 30 sec
V1 N1E
2754E
Record data (R1 - Trun in octal)
Wait 30 sec
KEY RLSE
N38E (hr,min,.01sec)
Record MARK TIME
KEY RLSE
(REJECT i.e. ΔR, ΔV > 0050.0) V37E 23E to 1
(UPDATE) PRO

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P51-53

<u>P27 CMC UPDATE</u>
CMC - on (req)

<u>Auto Update:</u>
1 V37E 00E
UP TLM CM - ACCEPT
Note: UPTLM(LEB) always ACCEPT
UPLINK ACTY lt - on
* POSS LOS before completion *
* If V33 N02 showing: *
* Key PRO *
* UPLINK ACTY lt - out *
* P00 displayed *
* If V21 N01 *
* or V21 N02 *
* Key V34E *
* UPLINK ACTY lt - out *
* P00 displayed *
* UP TLM CM - BLOCK *

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

Voice Transmission Update:

1 V37E 00E

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

3 P27 Displayed

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

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

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

7 POO Displayed

P30 EXTERNAL ΔV
If uplinked REFSMMAT, do P52 (PREF OPT) 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)
		PRO	
4	F 16 45	M,TFI,MGA	(0,min-sec,.01°)
		PRO (MGA set to -00002 if REFSMMAT Flag not set)	
		Set DET	
5	F 37	Note: For Closest Point of Approach, Load LOI TIG & ΔV=0,.1,0	

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)
		PRO	
4	F 16 45	M, TFI, MGA	(0,min-sec,.01°)
		PRO (MGA set to -00002 if REFSMMAT Flag not set)	
		Set DET	
5	F 37		

P34 TPI FRETHRUST (P74 LM)

P27

1 V37E (34E or 74E)

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

2 F 06 55 R2 ELEV ANG, R3 ωt (.01°,.01°)
Load desired values
+00000 in R2 to CALC ELEV
ANGLE AT TIG TIME)
PRO

P30-39

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

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

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(TPI (.1nm,.1fps,.1fps)
PRO (If Recycle - To 7)
(If Final - To 6)

P23

6 F 06 81 ΔVXYZ(LV)TPI (.1fps)
(For Out-Of-Plane Corr in final Comp only)
Key V90E
F 06 16 GET EVENT (hrs,min,.01sec)
PRO
F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
RECORD YDOT _____
PRO
INSERT-YDOT in R2 of ΔV TPI
* LOAD OF NEW DATA INTERRUPTED *
* BY F06 49, F50 18 OR RESTART *
* HANDLE INTERRUPTION *
* RELOAD DATA WHEN *
* N81 REAPPEARS *
PRO

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

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

9 F 37
P74 - Transmit Mnvr Parameters To LM

P40,41,47

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P35 TPM PRETHRUST (P75 LM)

1 V37E (35E or 75E)
F 16 45 MARK,TFI,-00001 (marks,min-sec)
(RECYCLE) V32E To 3
(FINAL PASS) PRO (Terminate Marking)

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

```
* LOAD OF NEW DATA INTERRUPTED *
* BY F06 49, F50 18 OR RESTART *
*    HANDLE INTERRUPTION       *
*    RELOAD DATA WHEN          *
*      N81 REAPPEARS           *
```

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

P37 RETURN TO EARTH PROGRAM

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

2 F 06 60 BLANK,V PRED,GAMMA EI (1fps,.01°)
Load desired values
For Min ΔV: Load +00000 in R2
For Mid-corridor: Load +00000 in R3
PRO

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

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

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

5 F 06 60 BLANK, V400K, GAMMA EI (fps,.01°)
(RECYCLE) V32E To 1
PRO

6 F 06 81 ΔVXYZ(LV) TIG (.1fps)
PRO (To 3 on first pass)

```
*F 05 09  00605  Solution Not  *
*                Convergent    *
*         00613  Flt Path Angle*
*                Not Reached   *
* RSET                         *
* V32E To 1                    *
```

7	F 04 06	THRUST OPTION (Do not key V82 during this display) R1 00007 R2 0000X X=1(SPS) 2(RCS) PRO	
8	F 06 33	TIG PRO	(hrs,min,.01sec)
9	F 16 45	MARK,TFI MGA PRO (MGA SET TO -00002 If No REFSMMAT SET)	(mark,min-sec,.01°)
10	F 37	(40E or 41E)	

P27

P30-39

P22

P23

P38 SOR TARGETING (P78 LM)

If P20 in background, do not start rend mark routine (V57,V54) until step 4

1	F 06 33	V37E (38E or 78E) TIG (SOR) Load desired TIG PRO	(hrs,min,.01sec)
2	F 06 55	R3 ωt Load desired ωt PRO	(.01°)
3	F 04 06	R1 00005 Specify Phase Option (Do not key V82 during this display) R2 0000X X=1 or 2 PRO (To 6 If R2=2)	
4	F 06 57	ΔR SOR Load desired ΔR PRO	(.1nm)
5	F 06 34	SOR TIME PRO	(hrs,min,.01sec)
6	F 16 45	MARK,TFI,-00001 (RECYCLE) V32E (FINAL PASS) PRO (Terminate Marks)	(mark,min-sec,.01°)
7	F 06 58	HP(SOR),ΔV(SOR),ΔV(SOR-FINAL) PRO	(.1nm,.1fps,.1fps)
8	F 06 81	ΔVXYZ(LV) PRO (If Recycle - To 6)	(.1fps)
9	F 16 45	MARKS,TFI MGA PRO (MGA SET TO -00002 IF NO REFSMMAT SET OR P78)	(marks,min-sec,.01°)
10	F 37	Transmit Mnvr Parameters To LM	

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P40,41,47

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

Transmit Mnvr Parameters To LM

SPS THRUSTING (P40)

P30 or P37 Complete
CMC - on
ISS - on
SCS - OPERATING
TEST C/W LAMPS
EMS MODE - STBY
EMS FUNC - ΔV SET
SET ΔV ind To 1586.8 fps
EMS MODE - AUTO
EMS FUNC - ΔV TEST
SPS THRUST LIT - on/off (10 sec)
ΔV ind. stops at -20.8 ± 20.7
EMS MODE - STBY
EMS FUNC - ΔV SET
SET ΔVC
EMS FUNC - ΔV
NONESS BUS - MNB

Cycle CRYO Fans

BMAG MODE (3) - RATE 2
ΔVCG - CSM
CMC MODE - FREE
AUTO RCS SELECT (16) - As req'd for ullage
LOAD DAP
ROT CONTR PWR NORM (both) - AC/DC
DET SET
V37E 00E
SC CONT - CMC
CMC MODE - AUTO

P27
P30-39
P22
P23
P40,41,47

P27

1			MNVR TO PAD BURN ATT V62E	
2			V49E	
3	F 06 22		DESIRED FINAL GMBL ANGLES LOAD MNVR PAD GMBL ANGLES PRO	(.01°)
4	F 50 18		REQ MNVR TO FDAI RPY ANGLES (AUTO) PRO (MAN) SC CONT - SCS MNVR to 6	(.01°)
5	06 18		AUTO MNVR TO FDAI RPY ANGLES	(.01°)
6	F 50 18		REQ TRIM TO FDAI RPY ANGLES (AUTO TRIM) PRO to 5 (BYPASS) ENTR	(.01°)
7			BORESIGHT & SXT STAR CHECK OPT MODE - CMC OPT ZERO - OFF	
8			V41 N91E	
9	F 21 92		SHAFT, TRUN LOAD SXTS angles	(.01°,.001°)
10	41		OPTICS DRIVE CHECK SXT STAR Drive Trunnion to <5° OPT ZERO - ZERO G/N PWR OPTICS - OFF CHECK BORESIGHT STAR (If avail)	

P30-59

P40,41,47

P23

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LM 103

11			V37E 40E	
12	F 50 18		REQUEST MNVR TO FDAI RPY ANGLES (.01°) (AUTO) BMAG MODE (3) - RATE 2 SC CONT - CMC CMC MODE - AUTO PRO to 13 (MAN/DAP) BMAG MODE (3) - RATE 2 SC CONT - CMC CMC MODE - 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 GDC ALIGN	(.01°)

TVC CHECK & PREP

STAB CONT SYS cb (Pnl 8) - close
SPS cb (12) - close
DEADBAND - MIN
RATE - LOW
LIMIT CYCLE - ON
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/RATE 2
ROT CONTR PWR DIRECT (both) - OFF
SCS TVC (2) - RATE CMD
If SCS, SCS TVC (2) - AUTO
* SC CONT - SCS *
TVC GMBL DRIVE P&Y - AUTO
MN BUS TIES (both) - ON
TVC SERVO PWR 1 - AC1/MNA
2 - AC2/MNB
TRANS CONTR PWR - ON
ROT CONTR PWR NORMAL 2 - AC
RHC #2 - ARMED

+54:00m
(-06:00)

LOI-MCC-1 ABORT

P51-54

55:00m (-05:00) **PRIMARY TVC CHECK**
GMBL MOT P1-Y1-START/ON(LMP confirm)
If SCS, verify Thumbwheel Trim
THC - CW
Verify NO MTVC

P27

SEC TVC CHECK
GMBL MOT P2-Y2-START/ON (LMP confirm)
SET GPI TRIM
Verify MTVC
THC NEUTRAL
GPI returns to 0,0(CMC) or trim (SCS)
ROT CONT PWR NORM 2 - AC/DC
(TRIM) Go to step 12
(BYPASS) BMAG MODE (3) - ATT1/RATE 2 (verify)
ENTR

P30-59

15 F 50 25 00204 GMBL TEST OPTION
(ACCEPT) SC CONT - CMC (verify)
PRO
Monitor GPI Response:
00,20,-20,00,02,0-2,00,Trim
*TEST FAIL: *
*SC CONT - SCS *
SCS TVC (2) - AUTO
(REJECT) ENTR

P40.41.47

16 06 40 TFI,VG,ΔVM (min-sec,.1fps)
PROG ALM - TIG Slipped
*V5N9E 01703 *
*KEY RLSE To 16 *
ROT CONTR PWR DIRECT (both) - MNA/B
SPS He VLVS (both) - AUTO (verify)
LIMIT CYCLE - OFF
FDAI SCALE - 50/15
SPS P2,Y2 cb - open (for crit. burn)

P23

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58:00 (-02:00) ΔV THRUST A(B)- NORMAL
THC - ARMED
RHC (both) - ARMED
TAPE RCDR - RECORD/STOP/HBR/FWD

59:25 (-00:35) DSKY BLANKS

59:30 (-00:30) (AVE G ON)
FLT RCDR - RECORD
EMS MODE - AUTO

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

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

MONITOR ΔVM (R3) COUNTING UP

LOI MODE I ABORT

103

P27

59:55
(-00:05)
F 99 40 ENG ON ENABLE REQUEST Don't use V34
(AUTO IGN) PRO AT TFI >0 Sec
(BYPASS IGN) ENTR To 19
~~V34E~~ - EXIT V37E 00E

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

06 40 TFC,VG,ΔVM (min-sec,.1fps,.1fps)
* F 97 40 SPS Thrust fail *
* ~~(TERM) V34E EXIT~~ *
* (RESTART)PRO to IGN *
* (RECYCLE ENTR to TIG-05 sec *

SPS THRUST LITE - ON ΔV THRUST B(A) - NORMAL
MONITOR THRUSTING
Pc 95-105 psia
EMS COUNTING DOWN
SPS INJ VLVS (4) - OPEN
SPS He VLVS tb - gray
SPS FUEL/OXID PRESS - 175-195 psia
PUGS - BALANCED
* PROG ALARM *
* V5 N9E 01407 VG INC *
* LOI & TEI *
* THC-CW, FLY MTVC *
* LOI_2 & MCC *
* ΔV THRUST A/B-OFF *

00:XX ECO

* EMER SPS CUTOFF: *
* ΔV THRUST A/B-OFF *
* LOI - BT +6 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 TB (2) - BP

SPS P2,Y2 cb - closed
GMBL MOTS (4) - OFF (LMP Confirm)
TVC SERVO PWR 1&2 - OFF
FLT RCDR - OFF
MN BUS TIES (both) - OFF
PRO

19 F 16 85 VG XYZ(CM) (.1fps)
NULL RESIDUALS (TEI & MCC)
RECORD ΔV CTR & RESIDUALS
EMS FUNC - OFF
EMS MODE - STBY
BMAG MODE (3) - RATE 2
DEADBAND - MAX
TAPE RCDR - STOP
NONESS BUS - OFF
TRANS CONT PWR - OFF
ROT CONTR PWR DIRECT - OFF
SPS P1&2,Y1&2 cb - open
PRO

20 F 37 V82E

21 F 16 44 HA,HP,TFF (.1nm,min-sec)
R3-59B59 HP >49.4 nm/35K ft
PRO

22 F 37 00E

23 V66E

BURN STATUS REPORT			
______	ΔTIG	______	VI
______	BT	______	HDOT
______	VGX	______	H
______	R	______	ΔVC
______	P	______	FUEL
______	Y	______	OXID
		______	UNBAL
REMARKS			

LOI MODE I ABORT

RCS THRUSTING (P41)

P30 or P37 Complete
CMC - on
ISS - on
SCS - OPERATING
TEST C/W LAMPS
EMS MODE - STBY
EMS FUNC - ΔV SET
SET ΔV ind to 1586.8 fps
EMS MODE - AUTO
EMS FUNC - ΔV TEST
  SPS THRUST Lt - on/off
  ΔV ind stops at -20.8 ± 20.7(10 sec)
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 (both) - AC/DC
DIRECT (both) - MNA/B
DET SET
V37E 00E
SC CONT - CMC
CMC MODE - 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

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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
Drive Trunnion to <5°
OPT ZERO - ZERO
CHECK BORESIGHT STAR (1f avail)

11 V37E 41E

12 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO) BMAG MODE (3) - RATE 2
SC CONT - CMC
CMC MODE - AUTO
PRO To 13
(MAN/DAP) BMAG MODE (3) - RATE 2
SC CONT - CMC
CMC MODE - 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
CMC MODE - AUTO
PRO To 13
(BYPASS) DEADBAND - 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 1t *
* 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

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59:30
(-00:30)

16 16 85 V X,Y,Z (AVE G ON)
TAPE RCDR - CMD RSET/HBR/RECORD/FWD
LIMIT CYCLE - OFF
EMS MODE - AUTO

00:00

17 F 16 85 VG X,Y,Z (.1fps)
NULL COMPONENTS
RECORD ΔV COUNTER & RESIDUALS
TAPE RCDR - STOP
HAND CONTROLLERS - LOCKED
EMS FUNC - OFF
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 V66E

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CSM 103

BURN STATUS REPORT	
_____ ΔTIG	_____ VI
_____ BT	_____ HDOT
_____ VGX	_____ H
_____ R	_____ ΔVC
_____ P	_____ FUEL
_____ Y	_____ OXID
	_____ UNBAL
REMARKS	

SCS

LOI MODE I ABORT

1

P47 Thrust Monitor Program

CMC - on
ISS - on & aligned
G/N PWR OPTICS - OFF

1 V37E 47E
F 16 83 ΔV XYZ(CSM) (.1fps)
* VI,HDOT,H available by N62E *
* KEY RLSE to return to N83 *
* In lunar orbit, add 2500nm to H*
(RECYCLE) V32E
(TERM) PRO

2 F 37 XXE

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LOI MODE I ABORT

ABORT - Stop Clock
ΔV Thrust A/B - OFF
Verify Thrust Off
SPS INJ VLVS(4) -CLOSED
SPS He tb(2)-bp
GMBL MOTS(4)-OFF (LMP Verify)
TVC SERVO PWR 1&2 - OFF
FLT RCDR - OFF
TAPE RCDR - STOP/LBR/FWD
SC CONT-SCS

RECORD DATA AND COMPUTE PAD

F 97 40
Record TFC 59 59
Vg _____
Vm _____
EMS Vc _____
ENTR
F 99 40
Maneuver to LOI_1 Attitude
ENTR
F 16 85
Record Vx _____
Vy _____
Vz _____
PRO
F37 V82E

F 16 44
Record H_A _____
H_p _____
TFF _____
PRO
F 37 00E
V66E

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PRIMARY
G&N ΔVm _____
VcABORT(Chart)_____
GET LOI_1 _____
Bt Watch + _____
+15:00
GET TEI ABORT__:__:__
Bt ABORT_____
from Nomigram for Vc
ABORT P&Y TRIM(Chart)

ALTERNATE
$\Delta VcLOI_1$ PAD _____
EMS Vc(Shutdown)- _____
Vc(Burned)_____
Vc ABORT(Chart)_____

MAN ATT PITCH - ACCEL CMD
SET In GDC THUMBWHEELS - (177.9,27.9,1.6)
MAN MNVR To ABORT R,P,Y
GDC ALIGN
CHECK DAP (P&Y TRIM)
EMS FUNC - ΔV SET
SET ΔV_c ABORT

TVC CHECK & PREP
STAB CONT SYS cb (Pnl 8)-Close
SPS cb (12) - close
Verify Rate - LOW
Limit Cycle - ON
MAN ATT(3)-RATE CMD
BMAG MODE(3)-ATT1/RATE2
ROT CONTR PWR DIR(2)-OFF
SCS TVC(2)-AUTO
TVC GMBL DRIVE P&Y-AUTO
VERIFY MN BUS TIES(2)-ON
TVC SERVO PWR 1 - AC1/MNA
TVC SERVO PWR 2 - AC2/MNB
TRANS CONTR PWR - ON
ROT CONTR PWR NORMAL #2-AC
RHC #2-ARMED

-5m

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

SEC TVC CHECK
GMBL MOT P2-Y2-START/ON(LMP Verify)
SPS P2-Y2 cb's - open
SET GPI TRIM
Verify MTVC
THC NEUTRAL
Verify GPI Returns To Trim POS
ROT CONT PWR NORM 2 - AC/DC
Verify DEADBAND - MIN
ROT CONTR PWR DIR(2) - MNA/B

LOI MODE I ABORT

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-2m

-10s
00

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SPS HE VLVS(2)-AUTO,Verify tb-bp
LIMIT CYCLE - OFF
Verify FDAI SCALE - 50/15
EMS MODE - AUTO
V37E 47E
ΔV THRUST A&B - NORMAL
Verify THC - ARMED
RHC (Both) - ARMED
TAPE RCDR - STOP/HBR/FWD
FLT RCDR - RECORD
ULLAGE
THRUST PB-PUSH
SPS THRUST LITE-ON
MONITOR THRUSTING
  Pc 95-105 psia
  EMS COUNTING DOWN
  SPS INJ VLVS(4)-OPEN
  SPS HE VLVS tb-GRAY
  SPS FUEL/OXID PRESS - 175 to 195 psi
ECO
 ΔV THRUST A/B - OFF
 VERIFY THRUST OFF
  SPS INJ VLVS(4)-CLOSED
  SPS He tb(2) - bp
  SPS P2-Y2 cb's - close
GMBL MOTS(4)-OFF (LMP Verify)
TVC SERVO PWR 1&2 - OFF
TAPE RCDR - OFF/LBR/FWD
FLT RCDR - OFF
NONESS BUS - OFF
BMAG MODE(3) - RATE 2
F 16 83
  RECORD Vx _____
         Vy _____
         Vz _____
  PRO
F37 00E
   V66E
EMS ΔV_c _____

SCS

No Comm

PSI-54

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P51 - IMU ORIENTATION

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

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

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

3 F 51 PLEASE MARK
OPT ZERO - OFF
MARK

4 F 50 25 00016 TERMINATE MARKS
PRO

5 F 01 71 OOODE 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

Note: Do not key V82 during step 1 or 2

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

1 V37E 52E
F 04 06 R1 00001 IMU ALIGN OPTION
R2 00001 PREF PRO to 4
2 NOM PRO to 2
3 REFSMMAT PRO to 5
4 LDG SITE PRO to 2

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

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

4 F 06 22 NEW ICDU ANGLES OG, IG, MG (.01°)
(IF MG>70°, MNVR) V32E - to 4
PRO NO ATT Lt - on then off

5 F 50 25 00015 STAR SELECT
(MNVR If Necessary)
(PICAPAR) PRO
*F 05 09 00405 NO PAIR *
(CREW SPECIFY) PRO - to 6
*(PICAPAR) V32E to 5 *
(MAN ACQ) ENTR

P77

P51-54

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CSM 103

6 F 01 70 000DE STAR CODE
Load desired code
OPT MODE - CMC (verify)
OPT ZERO - OFF
PRO to 8 (to 7 if DE=00)
F 05 09 00404 (TA>90°)
*MNVR - PRO To 8 *

7 F 06 88 CELESTIAL BODY VECTOR
Load desired vector
PRO
F 05 09 00404 (TA>90°)
*MNVR - PRO To 8 *

8 06 92 SHAFT, TRUN (.01°,.001°)
PROG ALARM (TA>50°)
*V5N9E 00407 *
*KEY RLSE *
*MNVR till R2<50000 *
(MARK ROUTINE) OPTICS MODE - MAN

9 F 51 PLEASE MARK
MARK

10 F 50 25 00016 TERMINATE MARKS
PRO

11 F 01 71 000DE STAR CODE
Load code (if necessary)
PRO to 6 after 1st MARK (to 12 if DE=00)
to 13 after 2nd MARK (to 12 if DE=00)

12 F 06 88 CELESTIAL BODY VECTOR
Load vector
PRO to 6 after 1st MARK
to 13 after 2nd MARK

SCS

No Comm

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CSM 103

13 F 06 05 STAR ANGLE DIFFERENCE (.01°)
If restart and 06 05 reappears
*with changed R1: *
*V32E to 15 *
*PRO to repeat sightings *
(REJECT) V32E to 15
(ACCEPT) PRO

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

15 F 50 25 00014 ALIGNMENT CHECK
(RECHECK) PRO To 5
(BYPASS) ENTR

16 F 37
OPT ZERO - ZERO
XXE

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P53 - BACKUP IMU ORIENT DETERMINATION

CMC - on
ISS - on
SCS - operating
MAN ATT (3) - MIN IMP
COAS LOS DETERMINATION - Complete pg G-74

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

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

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

4 F 53 PLEASE MARK
Center Target
ENTR

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

6 F 01 71 00ODE 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

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SCS
No Comm

P54 - BACKUP IMU REALIGN

Note: Do not key V82 during step 1 or 2
CMC - on
ISS - on
SCS - operating
MAN ATT (3) - MIN IMP
COAS LOS DETERMINATION - complete pg G-74

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 5
4 LDG SITE PRO to 2

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

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

4 F 06 22 NEW ICDU ANGLES OG, IG, MG (.01°)
(IF MG>70°, MNVR) V32E to 4
PRO - NO ATT Lt - on then off

5 F 50 25 00015 STAR SELECT
(Mnvr If Necessary)
(PICAPAR) PRO
*F 05 09 00405 NO PAIR *
(CREW SPECIFY) PRO to 6
*(PICAPAR) V32E to 5 *
(MAN ACQ) ENTR

6 F 01 70 000DE STAR CODE
Load desired code
PRO to 8 (to 7 if DE=00)

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7 F 06 88 CELESTIAL BODY VECTOR
Load desired vector
PRO

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

9 F 53 PLEASE MARK
Center Target
ENTR

10 F 50 25 00016 TERMINATE MARKS
(REJECT) ENTR to 9
PRO

11 F 01 71 000DE STAR CODE
Load code (if necessary)
PRO to 6 after 1st MARK (to 12 if DE=00)
to 13 after 2nd MARK (to 12 if DE=00)

12 F 06 88 CELESTIAL BODY VECTOR
Load vector
PRO to 6 after 1st MARK
to 13 after 2nd MARK

13 F 06 05 STAR ANGLE DIFFERENCE (.01°)
If restart and 06 05 reappears
*with changed R1: *
*V32E To 15 *
*PRO to repeat sightings *
(REJECT) V32E to 15
(ACCEPT) PRO

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

15 F 50 25 00014 ALIGNMENT CHECK
(RECHECK) PRO to 5
(BYPASS) ENTR

16 F 37 XXE

Nov. 6, 1968
Basic Date/Changed

P76 - TARGET ΔV

1		V37E 76E	
	F 06 84	ΔV XYZ	(.1fps)
		Load ΔV	
		PRO	
2	F 06 33	TIG	(hrs,min,.01sec)
		Load TIG	
		PRO	
3	F 37		

V41 N91 COARSE ALIGN OCDU's

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

1		V41N 91E	
2	F 21 92	SHAFT, TRUN NEW OCDU	(.01°,.001°)
		Load desired shaft and trun	
3	41	OPTICS DRIVE TO SPECIFIED ANGLES	

Nov. 6, 1968
Dec. 13, 1968

Basic Date
Changed

CSM 103

P51-54

V41 N20 COARSE ALIGN ICDU's

CMC - on
ISS - on

V41N 20E

2	F 21 22	NEW ICDU ANGLES RPY	(.01°)
		Load desired ICDU angles	
3	41	NO ATT Lt - on	
		*POSS PROG ALARM	*
		V5 N9 211 Coarse align error	
		*Repeat V41 N20	*
4		V40 N20E	
		NO ATT Lt - off	
		Wait 20 sec	
5		V37E XXE	

V42 GYRO TORQUING

CMC MODE - FREE

1		V42E	
	F 21 93	LOAD DELTA GYRO ANGLES (XYZ)	(.001°)
		(In flight - 90° max)	
2	42	NO ATT Lt - off	
		Monitor Gyro Torquing on FDAI	

Nov. 6, 1968
Dec. 13, 1968

Basic Date
Changed

CSM 103

SCS
No Comm

V48 - DAP ACTIVATION
CMC MODE - FREE

1
F 04 46 R1 ABCDE
R2 ABCDE
INSURE Left Digit of R1 is:
0-NO DAP
1-CSM
2-CSM/LM
3-SATURN DAP
6-CSM/LM ASC
PRO
PRO
PRO To Prog in progress
V46E

V48 - DAP DATA LOAD PROCEDURE

1 V48E
F 04 46 R1 ABCDE
R2 ABCDE

	A	B	C	D	E
	Vehicle Config	Quad A/C for Ẍ	Quad B/D for Ẍ	Att Deadband	Rate Select
R1	0 = No Dap 1 = CSM 2 = CSM & LM 3 = CSM & SIVB 6 = CSM & LM (Ascent Stg only)	0 = Fail A/C 1 = Use A/C	0 = Fail B/D 1 = Use B/D	0 = ± 0.5° 1 = ± 5.0°	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

V49 CREW DEFINED MANEUVER
CMC - on
ISS - on
SCS - operating

1 V37E 00E
V62E

2 V49E
OPR ERR Lt - on
RSET
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)

No Comm

V64 START S-BAND ANTENNA

1 V37E 00E

2 V64E
F 06 51 RHO, GAMMA (.01°,.01°)
S-BAND ANT - S
TRACK - MAN
Check P&Y Angle Ind
TRACK - AUTO
PRO

V67 - W-MATRIX ERROR DISPLAY

1 V67E
F 06 99 POS ERR, VEL ERR, OPT CODE (.01nm,.1fps)
R3 00001=Rend
00002=Orbital
00003=Cislunar

Load desired data
To reinitialize Cislunar W-matrix,
Load: R1 +00094
R2 +00057
R3 +00003

PRO

V74 CMC DOWNLINK

1 (If needed) V21 N01E 333E
F 21 01 R3 333
R1 20000E for 4 Dumps
or 10000E for 2 Dumps
or 04000E for 1 Dump

2 V74E (Places erasable memory on downlink)

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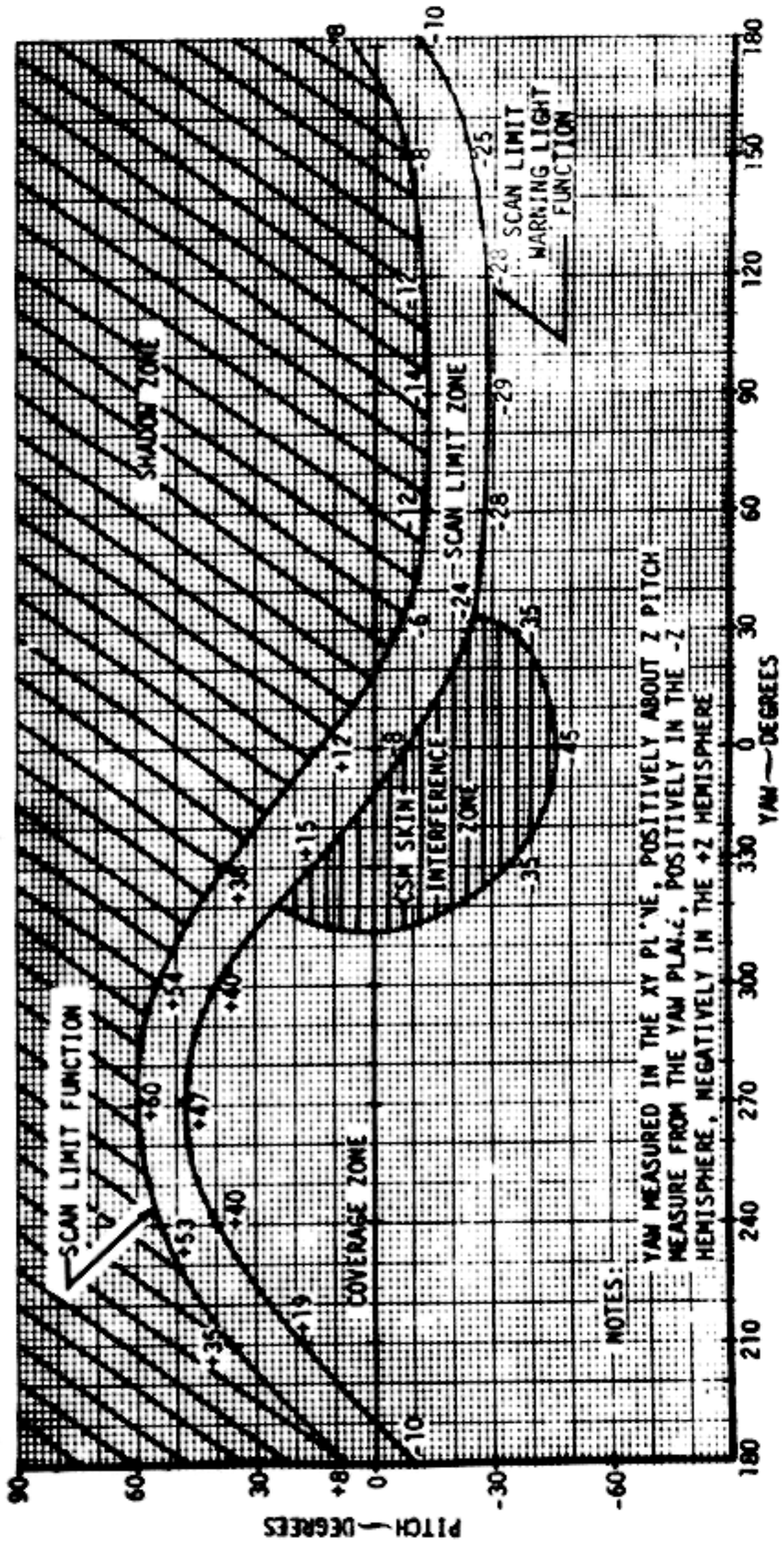
Basic Date:
Changed—

CSM 103



SCS

No Comm

Basic Date Nov. 6, 1968
Changed - Dec. 13, 1968

CSM 103

SCS

No Comm

V79 LUNAR LANDMARK

1		V37E 00E, V96E when COMP ACTY-out
2		V79E
	F 06 34	LAT - LONG TIME (hrs,min,.01sec) Load desired time PRO
3	F 06 31	LDG SITE TIME (hrs,min,.01sec) PRO
4	F 05 70	LMK CODE: R2=000DF (RECYCLE) V32E To 4 PRO
5	F 06 34	LMK TIME (hrs,min,.01sec) PRO To 4 Until 5 LMK Are Cycled Then Exit

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 06	R1 00002 Specify Vehicle R2 00001 CSM 00002 LM PRO
2	F 16 44	HA, HP, TFF (.1nm,.1nm,min-sec) (RECYCLE) V32E To 2 (Not Nec If AVE G On) (ΔR-miss dist DISP-P11 only) N50E To 3 (TF PER) N32E To 4 (EXIT) PRO
3	F 16 50	ΔR (miss dist) HP,TFF (.1nm,.1nm,min-sec) KEY RLSE To 2
4	F 16 32	TIME FROM PER (Useful only if TFF=-59B59) (hrs,min,.01sec) KEY RLSE To 2

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

V89 - RENDEZVOUS FINAL ATTITUDE

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

1 V37E OOE
V62E

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

Basic Date Nov. 6, 1968
Changed — Dec. 13, 1968

CSM 103

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

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

5 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 06 16 GET EVENT (hrs,min,.01sec)
Load desired time
PRO

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

V91 - COMPUTE BANKSUM

CMC - on (req)
V37E 00E

1 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

Basic Date Nov. 6, 1968
Changed — Dec. 13, 1968

CSM 103

SCS

No Comm

CMC SELF CHECK

1
F 21 01 — V25 NO1E, 1365E
E,E,E

2
F 15 01 — V15 NO1E, 1365E
R1 NUMBER OF ERRORS
R2 NUMBER OF TESTS STARTED
R3 NUMBER OF TESTS SUCCESSFUL

3 — V21 N27E 10E SELF TEST, FIXED & ERASABLE
(4E SELF CHECKS ERASABLE
5E SELF CHECKS FIXED)

4 — KEY REL
F 15 01 — TEST SUCCESSFUL WHEN R2≥3 (78 sec)
* IF PROG Lt - On *
* V05 N09E 01102 SELF *
* TEST ERROR *
(TERM) V21N27E 0E

MEASUREMENT & LOADING OF PIPA BIAS

1 — DET - RESET
S/C RATES <0.1°/sec

2 — V25N 21E, E,E,E/Start Event Timer

3 — V16 N21E
16 21 — XYZ PIPA COUNTS

4 — At T + 4:16 - VERB
T4:16
(X) R1 ____ (Y) R2 ____ (Z) R3 ____(XXXAB)

5 — V21N 01E
F 21 01 — LOAD 1452 E (CALCULATED X BIAS)E,E,(±ABXXX)
1454 E (CALCULATED Y BIAS)E,E
1456 E (CALCULATED Z BIAS)E

Basic Date Changed — Nov. 6, 1968

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Basic Date Changed — Nov. 6, 1968

CSM 103

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 OE

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

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

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

Key:

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

EXAMPLE: To set REFSMMAT flag:

Key:

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

SCS

No Comm

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

Basic Data Changed Nov. 6, 1968

C[illegible]103

Basic Data Changed Nov. 6, 1968

C[illegible]103

REVIEW DATA IN ERASABLE MEMORY

1		Perform During Any Flashing Display
2		V01 N01E (OCTAL ADD) E
3	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)

SCS

No Comm

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	00ODE 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

Basic Date Nov. 6, 1968
Changed Dec. 13, 1968

CSM 103

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	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

Basic Date Nov. 6, 1968
Changed Dec. 13, 1968

CSM 103

SCS

No Comm

DSKY CONDITION LIGHT TEST

CMC - on

1 Key V37E 00E (desired)
DSKY - P00

2 Key V35E

3 Monitor the following events
a. All DSKY condition lts - on

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

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

Wait 5 sec

d. All DSKY warning lts - off

e. ISS lt - off
CMC lt - off

f. Old PROG number will be displayed
Interrupted display (if any) will be restarted

MONITOR OF INPUT/OUTPUT CHANNELS

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

FLAG WORD LISTING

TITLE	ADDRESS	BIT	WHEN SET	WHEN RESET
RNDZ	00074	7	P20 initiated	P20 terminated
UPDATE	00075	7	State vector updating 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

SCS No Comm

CSM 103

Basic Date Nov. 6, 1968
Changed 12/13/68

Terminate	00103	15	Terminate R52,R53	Do not terminate
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 (ORBWFLAG)	00077	6	**P22, P23 W-matrix valid**	**P22, P23 W-matrix invalid**
3 axis	00101	6	MNVR Specified by 3 axis	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**

G-78

CSM 103

Basic Date Nov. 6, 1968
Changed

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

NON-FLAGS

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

G-79

A	B	C	D	E	1 Set / 0 Reset
15,14,13	12,11,10	9,8,7	6,5,4	3,2,1	

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

No Comm

SCS

V60-63 DESCRIPTION

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

V60 - Keying V60E will load present gimbal angles (N20) into N17 cells.

V61 - Keying V61E will display DAP phase plane errors on error needles provided the CMC has access to one of the FDAI displays.

V62 - Keying V62E will display the difference between present gimbal angles (N20) and N22 desired gimbal angles provided the CMC has access to one of the FDAI displays. The difference is resolved into CSM control axes before being displayed.

V63 - Keying V63E will display the difference between present gimbal angles (N20) and N17 (astronaut) desired gimbal angles provided the CMC has access to one of the FDAI displays. If V60E is keyed while V63 needles are active, the needles will be zeroed.

Basic Date Changed - Nov. 6, 1968

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CSM 103

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 (both) - AC1
SCS ELEC PWR - GDC/ECA (170 watts)
FDAI PWR - OFF (verify)
BMAG PWR (both) - ON (110 watts)
FDAI PWR - BOTH (104 watts)
AUTO RCS SELECT (16) - enable

SCS POWER DOWN

EMS FUNCTION - OFF
EMS MODE - STBY
FDAI SCALE - 5/1
FDAI SELECT 1/2
FDAI SOURCE - ATT SET
ATT SET - IMU
MAN ATT (3) - MIN IMP
ATT DEADBAND - MAX
RATE - LOW
TRANS CONTR PWR - OFF
ROT CONTR PWR NORMAL (both) - OFF
DIRECT (both) - OFF
AUTO RCS SELECT (16) - OFF
CMC MODE - FREE
BMAG MODE (3) - RATE 2
SCS TVC (both) - RATE CMD
.05G sw - OFF
dl/Pc sw - Pc
TVC GMBL DRIVES PITCH & YAW - AUTO
BMAG PWR (both) - WARMUP (38 watts)
TVC SERVO PWR (both) - OFF
FDAI PWR - OFF
LOGIC PWR 2/3 - OFF
SCS ELEC PWR - OFF
SIG COND/DRIVER BIAS PWR (both) - OFF

SCS

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

SCS ATTITUDE REFERENCE COMPARISON

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

1 Key V16 N20E (press IMU angs)

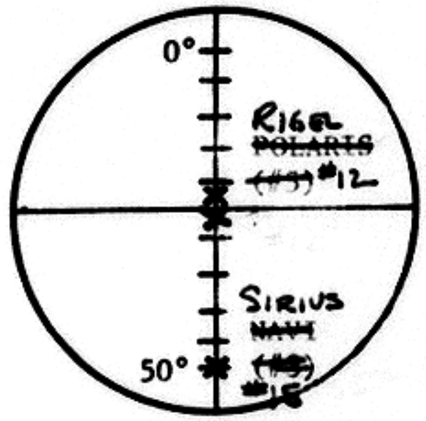
2 FDAI SELECT - 1
FDAI SOURCE - ATT SET
ATT SET - GDC
ATT SET dials - null FDAI 1 error needles
Key VERB when nulled (freeze display)
Record from DSKY:
R____°, P____°, Y____°
Record ATT SET dials:
R____°, P____°, Y____°

Basic Date Nov. 6, 19
Changed

Basic Da 11/6/68
Changed 12/13/68

03

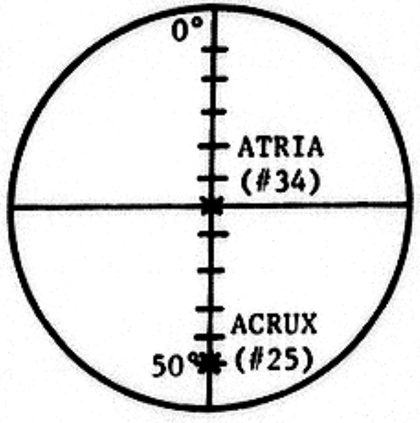
NORTHERN



SHFT 180° TRUN 7.5°

REFS			
R			
P			
Y			
REFS			
R			
P			
Y			

SOUTHERN



SHFT 180° TRUN 7.5°

REFS			
R			
P			
Y			
REFS			
R			
P			
Y			

Changed north set to SIRIUS & RIGEL @ GET 19:00 BASED ON RESULTS of JET star vis. ck.

No Comm

Basic Date — Nov. 6, 1968
Changed — Dec. 13, 1968

CSM 103

No Comm

BACKUP GDC ALIGNMENT (IMU FAILED)

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

1 Set SCT to 180° SHFT, 7.5° TRUN

2 ATT SET dials - R,P,Y ALIGN

3 MNVR to STARS:

	North	South
R line -	Polaris (5)	Atria (34)
50° Mark -	Navi (3)	Acrux (25)

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

BACKUP GDC & IMU ALIGNMENT (CMC FAILED)

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

1 Set SCT to 180° SHFT, 7.5° TRUN

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

3 CAGE IMU and hold

4 MNVR to STARS:

	North	South
R line -	Polaris (5)	Atria (34)
50° 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

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 06	00002 SPECIFY VEHICLE
		00001
		PRO
3	F 16 44	HA, HP (.1nm,.1nm)
		Calculate Average
		ALT SET - Set Average
		PRO
4		V83E
	F 16 54	R,RDOT,THETA (.01nm,.1fps,.01°)
		MODE - HOLD/FAST
		SLEW - To THETA
		MODE - OPR/SLOW
		PRO

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

1	FDAI 1 or 2 - ORB RATE EARTH/LUNAR - as req'd
2	MSFN Supply Altitude ALT SET - Set
3	SC +X at the horizon
4	MODE - HOLD/FAST SLEW FDAI MODE - OPR/SLOW

SCS

PASSIVE THERMAL CONTROL
(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°)

Nov. 6, 1968
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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 .1°/sec roll rate

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

Nov. 6, 1968
Basic Date Changed

No Comm

SCS

Basic Date Nov. 6, 1968
Changed Dec. 17, 1968

No Comm

P37 RETURN TO EARTH PROGRAM
(with -MA)

Nominal TEI - completed

1		V37E 21E
	F 04 06	R1 00002 R2 00001 PRO
2	F 06 34	GET LAT, LONG (hrs,min,.01sec) Load TEI TIG + 24 hrs. PRO
3	F 06 43	LAT, LONG, ALT V6N2E, 1107E
4	F 06 02	GERU If GERU>07990 V32E to 2 and increment time by 1 hr. IF GERU<07990 Rcrd GERU _____ Rcrd GET LAT, LONG _____ hrs _____ min _____ sec PRO
5	F 37	37E
	F 06 33	TIG (hrs,min,.01sec) Load TIG PRO
6	F 06 60	BLANK, V PRED, GAMMA EI (fps,.01°) Load R2 and R3 = +00000 PRO V24 N1E 3651E 70000E,E (-MA) KEY RLSE

SCS

7	F 06 61	IMPACT LAT, LONG PRO	(.01°)
8	F 06 39	ΔT TRANSFER PRO	(hrs,min,.01sec)
9	F 06 60	BLANK, V 400K, GAMMA EI PRO	(fps,.01°)
10	F 06 81	ΔVXYZ (LV) TIG PRO V16 N38E	(.1fps)
11	16 38	S.V. TIME	

```
*N38 oscilation (EI±5hrs)     *
* V96E                        *
* V37E 37E to 5 and           *
*  advance TIG by 15 min      *
*PROG ALARM:                  *
*  KEY RLSE-(F 05 09)         *
* V32E to 5 and use TIG       *
*   + 15 min                  *
*If second attempt Go to      *
*P37 RETURN TO EARTH PROGRAM  *
*     (without -MA) N.C.-4    *
```

12 KEY REL Lt - on

RCRD GET EI _____ hrs
(N38) _____ min
_____ sec

KEY RLSE

13	F 06 61	IMPACT LAT, LONG LONG _____.__ PRO	(.01°)

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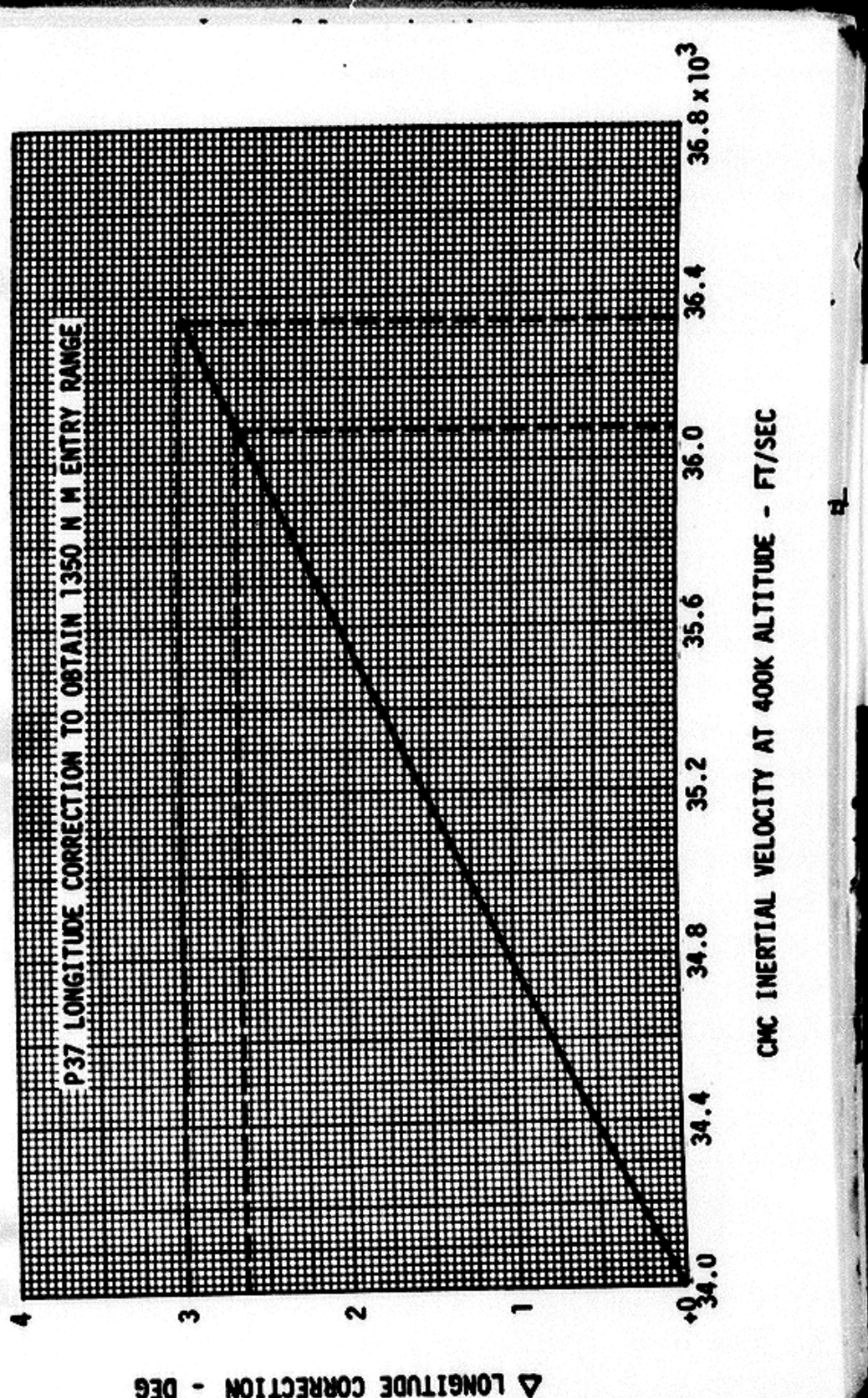

14 F 06 39 ΔT TRANSFER (hrs,min,.01sec)
Rcrd_____
PRO

15 F 06 60 BLANK, V400K, GAMMA EI (fps,.01°)
V400K _____
Determine ΔLong from V400K
vs Long Bias Chart
IMPACT LONG=LONG-ΔLONG= ____
PRO

16 F 06 81 ΔVXYZ (LV) TIG (.1fps)
Rcrd
ΔVX_____
ΔVZ_____
PRO

17 F 04 06 THRUST OPTION
R1 00007
R2 0000X
X=1 (SPS)
X=2 (RCS)
PRO

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

19 F 16 45 MARK, TFI,MGA (mark,min-sec,.01°)
Set DET
PRO (MGA SET TO-00002 IF
REFSMMAT FLAG NOT SET)

20 F 37 If IMPACT LONG unsatis, go to N.C.-7
If IMPACT LONG satis:
40E or 41E

Basic Date Nov. 6, 1968
Changed Dec. 17, 1968

SCS

N.C.-4

P37 RETURN TO EARTH PROGRAM

(without -MA)

Nominal TEI-completed
P37-with-MA-no solution

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1 V37E 37E
F 06 33 TIG (hrs,min,.01sec)
Load TIG (GET LAT, LONG from P21)
PRO

2 F 06 60 BLANK, V PRED, GAMMA EI (1fps,.01°)
Load R2 and R3 = +00000
PRO

3 F 06 61 IMPACT LAT, LONG (.01°)
PRO

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

5 F 06 60 BLANK, V400K, GAMMA EI (fps,.01°)
PRO

6 F 06 81 ΔVXYZ (LV) TIG (.1 fps)
PRO

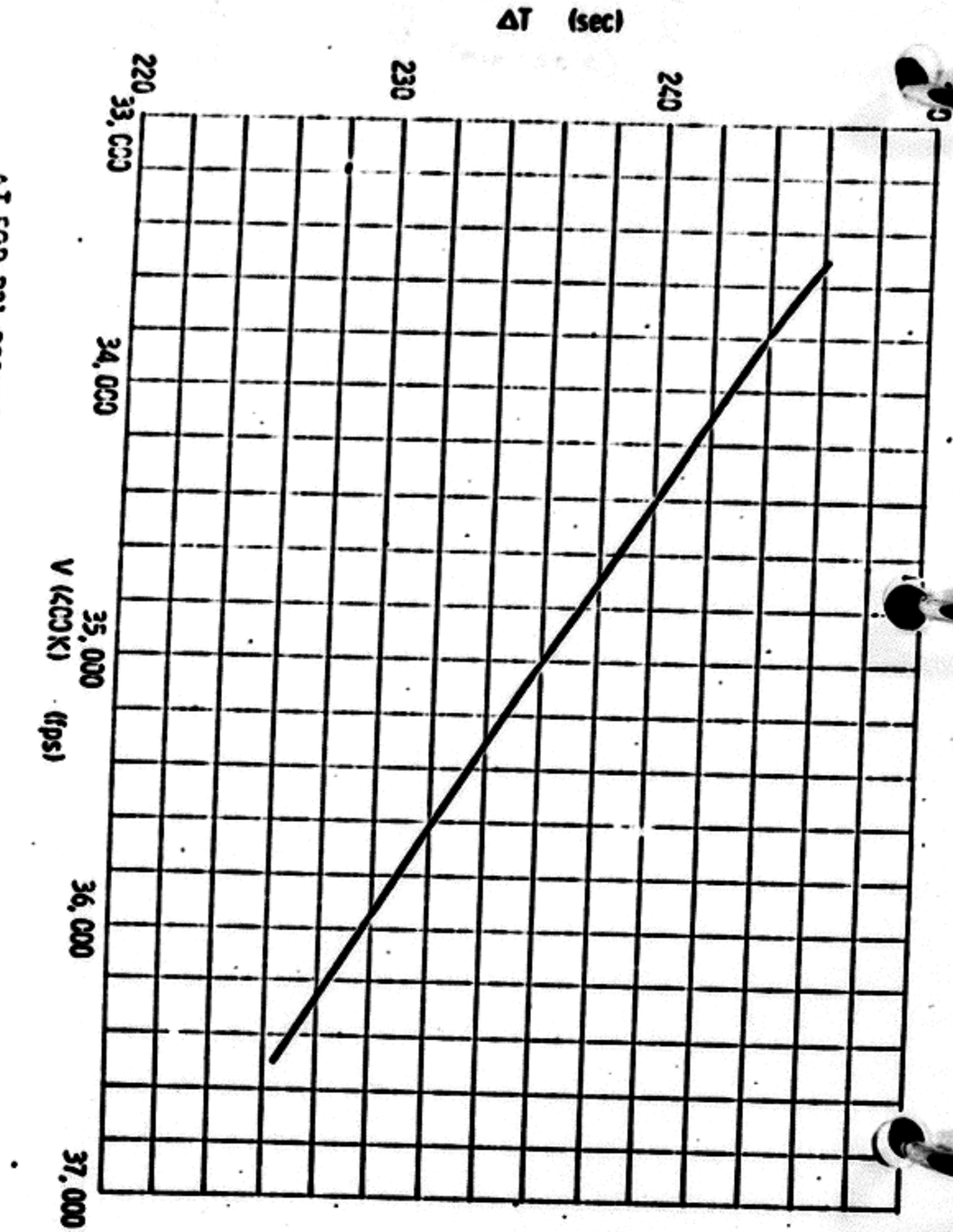
V16 N38E
When KEY REL-On, RCRD GET EI _____hrs
(N38) _____min
_____.__sec

KEY RLSE

7 F 06 61 IMPACT LAT, LONG (.01)
LONG _____
PRO

8 F 06 39 ΔT TRANSFER (hrs,min,.01sec)
Rcrd _____
PRO

9 F 06 60 BLANK, V400K, GAMMA EI (fps,.01)
V400K _____
Get Δ LONG from V400K vs Long Bias Chart
IMPACT LONG=LONG-ΔLONG=_____
δLONG=LONG(PAD)-IMPACT LONG
PRO



ΔT FOR P21 REQUIRED FOR 135° N.M. ENTRY RANGE SPLASH PREDICTION

Basic Date Nov. 6, 1968
Changed Dec. 17, 1968

10 F 06 81 Rcrd ΔV's
ΔVX _____ .
ΔVY +0000.0
ΔVZ _____ ,

11 V37E 00E
Go to N.C.-7
& calculate burn to achieve
PAD LONG

LANDING SITE DETERMINATION FOR P61

Last MCC-complete and targeted via P37 procedure

1 V37E 21E
F 04 06 R1 00002
R2 00001
PRO

2 F 06 34 GET LAT, LONG see below
Load GET EI (N38) or ~~RET .05G (PAD)~~
plus ΔT from V400k vs ΔT chart
___ ___ . GET EI (N38)
+ ___ ___ . ΔT
___ ___ . GET LAT, LONG(N34)
PRO

3 F 06 43 Rcrd _____ . LAT (P61)
_____ . LONG
+ 1.00
Add 1.00° to LONG _____ . LONG (P61)
PRO

4 F 37 XXE

If no P37 (-MA) then determine GET EI by iterating P21 to an altitude solution of 66 nm. Start by using RET .05G (PAD)

SCS

N.C.-6

ENTRY ALIGNMENT (No comm)

To be performed at TEI + 1 hr
P37 targeting-complete

1 V37E 30E
F 06 33 GETI (hrs,min,.01sec)
Load GET EI (N38) from P37-with -MA
or RET .05G (PAD)
PRO

2 F 06 81 ΔVXYZ (LV) (.1fps)
Load ΔVX=00100
ΔVY=ΔVZ=+00000
PRO

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

4 F 16 45 M, TFI, MGA (0,min-sec,.01°)
PRO

5 F 37 40E

6 F 50 18 V37E 52E
PERFORM P52, PREFERRED OPTION
(pg G-56)

SC ORIENTATION FOR NO COMM RTE MCC-NO IMU
P37 tarteting - complete
ΔV's determined: ΔVX= _____.
ΔVY= _____.
ΔVZ= _____.

1 V 37E 30E
F 06 33 GETI
Load GET of MCC
PRO
2 F 06 81 ΔVXYZ(LV) (.1fps)
Load ΔV's from above
PRO
3 F 06 42 HA,HP,ΔV(REQ)
Rcrd ΔV(REQ) _____.
V37E00E
Calculate r = ΔVZ/ΔV(REQ) _____.
Calculate Θ= $\sin^{-1}(r)$= .

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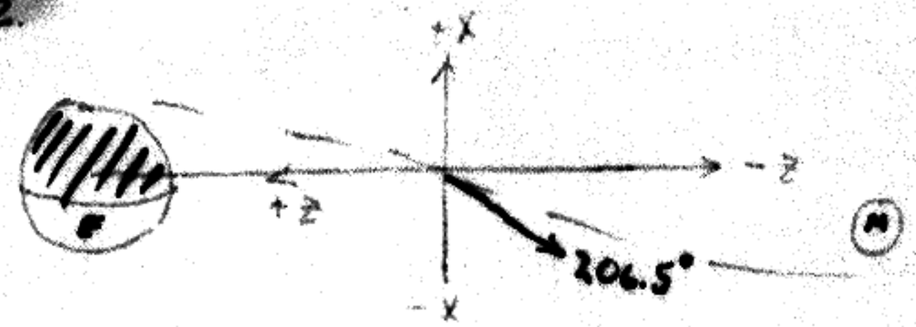
Notes:

1. If no longitude control required make Θ = 0. ∴ burn will be 090 or 270 after FDAI (SCS) alignment.

2.



3. To determine Θ use S scale (black figures) for angles use C scale for r values.
Direct readout. Θ takes same sign as r.

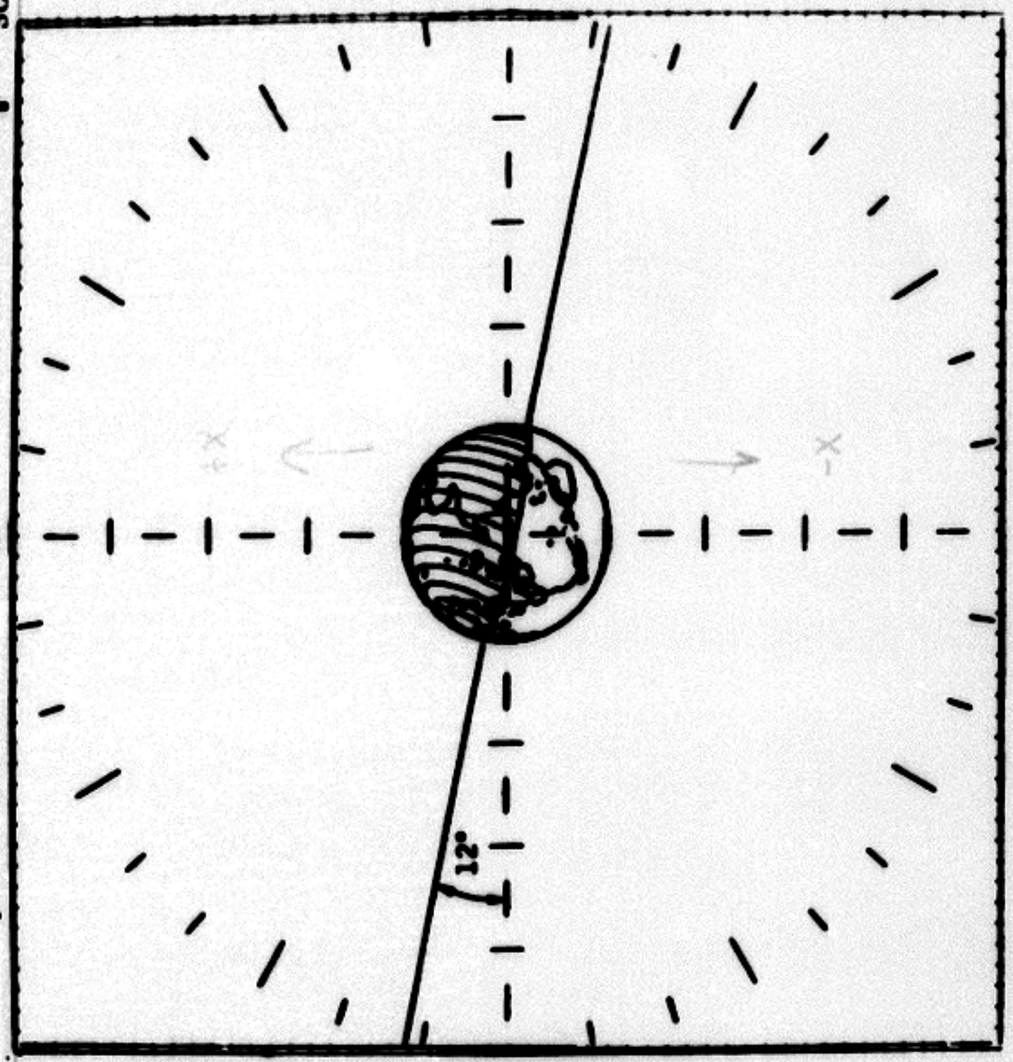
Example ΔVZ = −40'/sec
ΔVX = −20'/sec
ΔV(REQ) = 44.7'/sec

∴ $r = \frac{\Delta VZ}{\Delta V(REQ)} = \frac{-40}{44.7} = -.895$

∴ Θ = −63.5°

Burn angle would be
Δ∠ = 90° − (−63.5) = 153.5°
Ball angle = 360 − 153.5 = 206.5°

SCS



- Inplane orientation of the [illegible]'s terminator for midcourse corrections during the [illegible] earth coast.

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N.C.-7

4 Center earth in COAS:
Terminator - horizontal
Sunlit side down (+Z SC)

5 Roll left 6° - slow return
12° - fast return

6 FDAI SELECT - 1
FDAI SOURCE - ATT SET
ATT SET - GDC
ATT SET dials - 0°, 0°, 0°
GDC ALIGN PB - push

7 If ΔVX positive: pitch up 90°-θ°
If ΔVX negative: pitch down 90°-θ

8 Perform burn: ΔV(REQ)

LONG CONTROL FOR NO COMM

ignore with -ma → MCC 6 & subs - go to 3
ΔVX(P37) ____.
ΔVZ(P37) ____.

ΔT TRANSFER ____ ____ ____ (N39)
(Biased) IMPACT LONG (N61) ____.

V400K ____

1 Enter GERU vx RADIAL SPEED chart.
Find REF point corresponding to GERU and either V400K or ΔT TRANSFER
Move along GERU line the desired ΔLONG or ΔΔTTRANSFER (Each ΔTRANS line=30°).
Rcrd ΔRADIAL SPEED (i.e. distance between pts. in fps):
ΔVZ(LONG)=ΔVZ(DES)-ΔVZ(REF)
____=____-____
Determine Avg. V400K between DES pt and REF pt.

Enter GERU vs K chart
Use GERU and Avg V400K to determine
K= .

SCS

N.C.-8

Calc ΔVX(LONG)=(K)X ΔVZ(LONG)

_____ . __ =. __ X _____

Calc P30 ΔV's:

ΔVX(P30)=ΔVX(P37)+ΔVX(LONG)= _____ .

ΔVY=0 = _____ .

ΔVZ(P30)=ΔVZ(P37)+ΔVZ(LONG)= _____ .

ΔV's not acceptable or GERU vs RADIAL SPEED chart too small, go to 3 for corridor control only

2 V37E 30E To P30 pg G-35

Use ΔVX(P30),ΔVY(P30),ΔVZ(P30)

Use GET LAT, LONG for GETI

3 Enter GERU vs K chart

Use GERU and V400K to determine

K = . _____

Calculate K XΔVZ(P37)= _____

Calculate ΔVX(P30)=ΔVX(P37)-KΔVZ(P37)

_____ = _____ - _____

4 V37E30E to P30 pg G-35

Use ΔVX(P30)

ΔVY(P30)=ΔVZ(P30)=0

Use GET LAT, LONG for GETI

Basic Date Nov. 6, 1968

Changed Dec. 17, 1968

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Changed

Loss of Communication Navigation Procedure

1. Before TL1+32 hrs:

   a. Make abort burn.

   b. Re-initialize w-matrix. (MIT says no but NASA says yes)

   c. Initiate sightings as soon as possible after abort (3 sets)

   d. Scan stars on Fly-by (FB) for possible targets (preliminary data indicates stars available for last half of aborts nearly identical to FB).

   e. Three sets every 2.5 hours for 20 to 40 hour return times.

   f. Last interval before final MCC starts at MCC-1.5 hour and consists of 5 sets.

2. After TL1+32 hrs:

   a. Make sightings as per nominal flight plan.

   b. If possible, add extra sightings close to moon.

   c. Re-initialize w-matrix at perilune.

   d. Proceed with fly-by schedule as per Figures 1(a)(b)(c)(d).

3. LO aborts (detailed schedules provided - Figures 1(a)(b)(c)(d)

   a. The first and last 17 hours of the schedule should not be changed.

   b. The data in the middle of the TE leg may be moved around for rest periods and MCC's.

   c. Change to EI chart at EI-40.

4. Fly-by aborts (schedule provided Figures 2(a)(b)(c)(d).

   a. Fly-by schedule for communication loss on trans-lunar (TL) leg assumes TL sightings made as per nominal schedule.

   b. Data provided is for pericynthion of 60n.mi. (data for higher perisynthion will be similar but AOS and LOS times may vary).

   c. Pericynthion greater than 60 n.mi. check LO abort chart for additional targets.

5. General trans-earth optical navigation rules:

   a. A sighting is to consist of three marks.

   b. A sighting interval is to consist of as least 3 star/horizon sightings - two stars as close to the orbit plane as possible and one star as far out of the orbit plane as possible.

   c. 15 sightings within the LSOI.

      (1) At least 8 lunar sightings, as soon after TEI as possible and before TEI + 3 hours.

      (2) Three sighting intervals within the LSOI.

   d. At least 4 sightings prior to a MCC and at least 3 sightings after each MCC except the last MCC.

   e. In the interval 35000 n.mi. from the moon to 100,000 n.mi. from the earth use at least 5 sighting intervals spaced evenly.

   f. 25 sightings within 100K n.mi. radius of the Earth.

      (1) One hour of optical sightings preceding the last MCC at Entry - 2 hours.

      (2) One sighting interval must use the moon as reference body and must precede the last sighting interval prior to MCC at Entry - 2.

Changed ____ Basic Date Dec. 17, 1968 Changed ____

DIRECT ABORT PROCEDURES

Time From	
*DAM+	P23 - 3 sets ENH Stars 22, 26, 31.
DAM + 1 hr	Determine ENTRY Alignment (N.C. -6) IMU Realign P52 Option 1-Preferred
DAM + 2.5 hrs.	P23 - 3 sets ENH Stars 22, 26, 31. 1 set LH stars 33N,40N,42F,45F -for abort after TLI+20hrs
DAM+3hrs	P37 Criteria for MCC $\Delta V > 1$ fps. IMU Realign P52 Option 2-REFSMMAT(If MGA $> 45^{\circ}$ do a preferred align specified by P40/41
DAM + 5 hrs.	MCC_1
DAM + 6 hrs.	P23 - 3 sets (22,26,31 for remainder of sighting)
DAM + 11 hrs.	P23 - 6 sets
DAM + 12 hrs.	P37
EI - 11 hrs	P23 - 6 sets
EI - 7 hrs	IMU Realign P52 Option 3 - REFSMMAT
EI - 6 hrs	P23 - 3 sets
EI - 4 hrs	P23 - 3 sets
EI - 3 hrs	P 37 Landing Site Determination for P61 (N.C
EI - 2:30 hrs	MNVR To Burn Attitude
EI - 2 hrs	MCC
EI - 1:50 hrs	P23 - 1 set

EI - 1:35 hrs IMU Realign P52 Go to E-6 (P)
Option 3 - REFSMMAT

* DAM - Direct Abort Maneuver

Basic Date Nov. 6, 1968
Changed Dec. 17, 1968

Channel _____

FRESH START RECOVERY (Not Verified)

In case of a CMC Fresh Start (Blank Prog Register) and no distruction of E-Memory
No 1107 Alarm

Attempt:

Validate CMC if GND Support is not available

1. V36E
2. V48 Load DAP
3. V46 Start DAP
4. V16N36E Verify CMC Clock and Correct if necessary (V55)
5. Verify CSM & LM State Vectors Via P21 and available NAV check Data
   NOTE: If in lunar sphere - CMoon Flag and LMoon Flag will have to be set via V25N07E 104E 6000E 1E
6. V37E 00E
7. Validate REFSMMAT Cells: V25N07E 77E 10000E 1E Call P52 and verify. Do P51 if invalid.
8. Select P47 and observe ΔV's (To observe proper Pipa Compensation) Exit P47 and call P00 anytime after average G Starts (To insure proper initialization of IMU drift compensation routines.)
9. Most Ephem Data can be verified by using P22 Auto Optics on a known Lunar Ldmk (CSM altitude less than 425 NM) or using P23 Auto Maneuver and Optics LLos on a Lunar Landmark (CSM alt greater than 425 NM

SYSTEMS MANAGEMENT TABLE OF CONTENTS

PROPULSION SYSTEM

1 **SPS MONITORING CKS**

SPS PRPLNT TK TEMP - +45° to +75°F
* If <45°F-SPS LINE HTR-A *
SPS PRPLNT TK PRESS: He - 3900 psia max.
N2A & B - 2900 psia max.
SPS PRESS IND sw - He
FUEL & OXID PRESS - 170-195 psia
SPS ENG INJ VLVS (4) - CLOSE
SPS OX, FUEL & UNBAL QTY - record
OXID FLOW VLV - PRIM
SPS He VLV (both) - AUTO
SPS He VLV tb (both) - bp

2 ▲**SM RCS MONITORING CK**

SM RCS SEC PRPLNT tb (4) - bp (If PRIM in use)
SM RCS He 1 & 2 tb (8) - gray
SM RCS PRIM PRPLNT tb - gray (If PRIM in use)
RCS IND sw - SM A, B, C, D
PKG TEMP - 105-195°F
He PRESS - record
MANF PRESS - 178-192 psig
He TK TEMP - record
PRPLNT QTY - record
When PRPLNT QTY is 43%: (He PRESS tbd psig)
SM RCS SEC PRPLNT A(B,C,D) - ON
SEC PRPLNT A(B,C,D) tb - gray
PRIM PRPLNT A(B,C,D) - OFF
PRIM PRPLNT A(B,C,D) tb - bp

3 ▲**CM RCS MONITORING CK**

CM RCS PRPLNT tb (both) - bp
RCS IND sw - CM 1,2
He TEMP - 60-90°F
He PRESS - 4000-4450 psia
FUEL & OXID PRESS - 15-125 psia
After CM RCS Activation:
He PRESS-3700-4150 psia
FUEL & OXID PRESS - 285-302 psia
CM RCS HTRS - OFF

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Basic
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CSM 103

EPS PERIODIC VERIFICATION AND TESTS

1 Cryogenic Pressure - Quantity Check

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

80-100% - 4 hr
50-80% - 8 hr
* c&w LT - out before *
* continuing *

2 FC Power Plant Check

FC IND sw - 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 TB (2) - gray
FC RAD TB (3) - gray
FC REACS (3) - gray
FC REACS & RAD cb (6) - out all others in (verify)

3 DC Voltage-Amperage Check

MN BUS TIE (both) - 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 (34-38 vdc <3 amp)
PYRO BAT A, B (37 VDC)
DC IND - MAIN BUS B
SYS TEST 4B (BAT RLY BUS - 3.7-4.1 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

TO PYRO BAT ck desired:
Pyro A/B sep A/B cb (out) - close
Pyro A/B sep A/B cb (out) - open

4 AC VOLTS - 115 ± 2 all PHASES

Rev. 6, 1968
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Basic Date Changed

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5 Battery Charging BAT A (B)

MAIN BUS TIE A/C (B/C) - OFF
BAT BUS A & B PYRO BUS TIE cb - open (verify)
BAT C BAT BUS A & B cb - open
BAT RLY BUS BAT A(B) cb - open
DC IND sw - BAT CHARGER
BAT CHARGE - A(B,C)
  DC VOLTS - 37.5-40 vdc
  DC AMPS - 2.0-0.4 amps
BAT CHARGE - OFF at 0.4 amps or 100% re-charge
BAT RLY BUS BAT A(B) cb - closed
SYS TEST 4A (BAT VENT <1.5)
If >1.5: BAT VENT VLV -
VENT (to~0) then CLOSED

6 Fuel Cell Power Plant Purging

A. 02 PURGING
FC IND sw - 1(2,3)
FC PURGE 0 1(2,3) - 02 (2 min.)
FC FLOW-02 Flow incr 0.6 lb/hr
M/A FC 1(2,3) - On/Reset
FC PURGE - 1(2,3) - OFF

B. H2 PURGING
H2 PURGE LINE HTR - ON (20 min prior)
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
M/A FC 1(2,3) - On/Reset
FC PURGE - 1(2,3) - OFF
H2 PURGE LINE HTR - OFF

7 H2 or 02 Quantity Balance Correction

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

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
PRIM RAD tb - gray
*If PRIM RAD tb - 2 *
* ECS RAD FLOW AUTO CONT - 1 until *
* tb gray, then AUTO *
ECS RAD TEMP PRIM IN - 67-97° F
ECS RAD TEMP PRIM OUT - -20° to +63°F (-20° to 97°F for lunar orb)
REPRESS 02 >865 psia
+GLY EVAP PRIM TEMP OUT - 40-50.5°F
+GLY EVAP PRIM STEAM PRESS
.1-.15 boiling, > .16 not boiling
+PRIM GLY DISCH PRESS - 40-52 psig
+SUIT TEMP - 45-55°F
+CABIN TEMP - 70-80°F
+SUIT PRESS/CABIN PRESS - 4.8-5.2 psia(14.7 for launch)
+PART PRESS CO2 < 7.6 mm Hg
+SUIT COMP ΔP - 0.3-0.4 psid
+PRIM GLY ACCUM QTY 30-70% (expect 20-50% at insert)
*If <30% - PRIM ACCUM FILL vlv - *
* ON (until 40-55%) *
+POT H20 QTY - 10-100%
+WASTE H20 QTY - 25-85%
*If >85% - Dump, pg S-15

SYSTEMS MANAGEMNT

2 **ECS PRE-TLI/LOI REDUNDANT COMPONENT CK**

- Suit Compressor
  - SUIT COMPR (both) - sw to other compr
  - SUIT COMPR ΔP ind - 0.3-0.4 psid
- Main O2 Regulators
  - MAIN REG B vlv - close
  - EMER CABIN PRESS vlv - 1
  - PUSH TO TEST PB-PUSH (O2 FLOW INC)
  - O2 press - 90-110 psig (from MSFN if avail)
  - MAIN REG B vlv - open
  - MAIN REG A vlv - close
  - EMER CABIN PRESS vlv - 2
  - PUSH TO TEST PB - PUSH (O2 FLOW INC)
  - O2 press - 90-110 psig (from MSFN if avail)
  - MAIN REG A vlv - open
  - EMER CABIN PRESS vlv - BOTH (OFF if suited)
- Secondary Glycol Loop
  - Open cool atten panel (If req'd)
  - EVAP H2O CONT SEC vlv - AUTO
  - ECS IND sw - SEC
  - SEC COOL LOOP PUMP - AC1
    - GLY DISCH SEC PRESS - 39-51 psig
    - ACCUM SEC QTY IND - 30-55%
  - SEC COOL LOOP EVAP - EVAP
  - SEC EVAP STEAM PRESS .1-.15 boiling
>.16 not boiling
  - After 5 min
    - SEC EVAP TEMP OUT - 40-50.5°F
  - SEC COOL LOOP EVAP - RESET for 58 sec minimum,
then off (ctr)
  - ECS IND sw - PRIM
  - SEC COOL LOOP PUMP - off (ctr)
  - EVAP H2O CONT SEC vlv - OFF

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Changed Dec. 4, 1968
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3 **ECS PERIODIC REDUNDANT COMPONENT CK**

- Main O2 Regulators
  - MAIN REG B vlv - close
  - EMER CABIN PRESS vlv - 1
  - PUSH TO TEST PB-PUSH (O2 FLOW INC)
  - O2 press - 90-110 psig (from MSFN if avail)
  - MAIN REG B vlv - open
  - MAIN REG A vlv - close
  - EMER CABIN PRESS vlv - 2
  - PUSH TO TEST PB - PUSH (O2 FLOW INC)
  - O2 press - 90-110 psig (from MSFN if avail)
  - MAIN REG A vlv - open
  - EMER CABIN PRESS vlv - BOTH (OFF if suited)
- Secondary Glycol Loop
  - Open cool atten panel (If req'd)
  - EVAP H2O CONT SEC vlv - AUTO
  - ECS IND sw - SEC
  - SEC COOL LOOP - AC 1 (AC 2)
    - GLY DISCH SEC PRESS - 39-51 psig
    - ACCUM SEC QTY IND - 30-55%
  - SEC COOL LOOP EVAP - EVAP
  - SEC EVAP STEAM PRESS .1-.15 boiling,
>.16 not boiling
  - After 5 min
    - SEC EVAP TEMP OUT - 40-50.5F
  - SEC COOL LOOP EVAP - RESET for 58 sec minimum,
then off (ctr)
  - ECS IND sw - PRIM
  - SEC COOL LOOP PUMP - off (ctr)
  - EVAP H2O CONT SEC vlv - OFF

ECS SPECIAL PROCEDURES

1 GLYCOL ACCUMULATOR REFILL (IF <30%)

PRIM ACCUM FILL vlv - ON
GLY ACCUM PRIM QTY - 40-55%
PRIM ACCUM FILL vlv - OFF
IF OVER FILL
GLYCOL RESVR INLET - OPEN (MOM)

2 CO2 ABSORBER FILTER REPLACEMENT

CO2 CSTR DIVERT vlv - A(B)
BLEED vlv - PRESS
COVER LATCHING HANDLE - UNLOCK
REPLACE FILTER
COVER LATCHING HANDLE - LOCK
SHIM STOWAGE - B5 & B6

3 DEBRIS SCREEN CHECK

Check cabin ht exch inlet screen
Check SUIT RET AIR vlv screen
CABIN FANS (both) - OFF
SUIT RET AIR vlv - CLOSE (PUSH)
Clean screens
SUIT RET AIR vlv - OPEN (PULL)
CABIN FANS (both) - on

Basic Dated Nov. 6, 1968
Changed Dec. 4, 1968

CSM 103

4 POTABLE WATER CHLORINATION

Unstow chlorination unit
Remove chlor port cap
Attach needle assembly to injection port
Insert chlorine ampoule into casing
Connect knob assembly & rotate (CW) until piston contacts ampoule
Install ampoule assembly on needle assembly (push & turn CW)
Rotate knob (CW) until ampoule is empty (3 turns for half empty if H2O qty <50%)
Disconnect ampoule assembly from needle assembly
Rotate knob CCW & stow used ampoule
Repeat above steps with buffer ampoule
Replace chlor port cap — POT H2O - OPEN
Stow chlorination unit — wait 10 min.
Remove 1 ampoule of H2O

Do not drink for 30 min

PGA MODE CHANGES

1 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
Don lt wt hdsets
SUIT PWR - ON
PWR - AUDIO/TONE
SUIT FLOW vlv - CABIN FLOW (unsuited)

2 DONNING PGA

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 (suited)
SUIT RET AIR vlv - CLOSED (PUSH)
EMERG CABIN PRESS vlv - OFF

3 PARTIAL SUIT CKLIST

EMER CAB PRESS vlv - BOTH
SUIT CKT RET vlv - OPEN (Pull)
Reverse O2 umbilicals

Basic Dated Nov. 6, 1968
Changed Dec. 4, 1968

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4 DISCONNECTING COMM UMBILICAL

Before disconnecting umbilical from head set:
- SUIT PWR - OFF
- POWER - OFF
- AUDIO CONT - NORM

5 SUIT CKT INTEGRITY CK

DIRECT O2 vlv - CLOSE (CW)
SUIT PRESS - 4.8-5.2 psia
O2 FLOW - 0.2-0.4 lb/hr
SUIT TEST vlv - PRESS
- O2 FLOW - 1.0 lb/hr (pegged)
- O2 FLOW HI lt - ON
- M/A - ON, Reset
- SUIT PRESS - 8.9-9.7 psia
- PGA PRESS (3) - 4.1-4.5 psig

O2 DEMAND REG vlv - OFF
- O2 FLOW - 0.2 lb/hr (pegged)
- O2 FLOW HI lt - OFF
- PGA PRESS (3) - 0.5 psi/min decay

O2 DEMAND REG vlv - Both (O2 flow inc)
SUIT TEST vlv - DEPRESS
- O2 FLOW - 0.2-0.4 lb/hr
- SUIT PRESS - slightly > CAB PRESS

SUIT TEST vlv - OFF

6 PGA INTEGRITY CK

DIRECT O2 vlv - CLOSE (CW)
SUIT PRESS - 4.8-5.2 psia
O2 FLOW - 0.2-0.4 lb/hr
SUIT TEST vlv - PRESS
- O2 FLOW - 1.0 lb/hr (pegged)
- O2 FLOW HI lt - ON
- M/A - ON, Reset
- SUIT PRESS - 8.9-9.7 psia
- PGA PRESS (3) - 4.1-4.5 psig

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 - OFF
- O2 FLOW - 0.2-0.4 lb/hr
- SUIT PRESS - slightly >CAB PRESS

SUIT TEST vlv - OFF

CABIN ATMOS MODE CHANGES

1 CM PRESSURE DUMP

EMER CABIN PRESS vlv - OFF (verify)
CAB REPRESS vlv - OFF (verify)
SUIT RTN AIR vlv - CLOSED (verify)
CABIN FANS (both) - OFF
DIR O2 vlv - CLOSE (CW)
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

CAB PRESS REL vlv (both) - NORMAL (latch on)

2 CABIN REPRESS (NORM, 30 min)

CAB PRESS REL vlv (both) - NORMAL (latch on)
MONITOR SURGE TANK PRESS
PLSS vlv - FILL
REPRESS O2 vlv - OPEN
AT 150 psia ON SURGE TANK:
- PLSS vlv - OFF
- CABIN REPRESS vlv - ADJUST TO 150 psia on SURGE TK

AT ZERO psia on EMERG O2 GAUGE:
- REPRESS O2 vlv - CLOSE

CAB REPRESS vlv - OPEN (CW)
WHEN CABIN PRESS = 4.7-5.3
- CAB FAN (both) - ON
- O2 PRESS ind - TANK 1
- CAB REPRESS - CLOSE (CW)

3 CABIN REPRESS (ALT, 52 min)
CAB PRESS REL vlv (both) - NORMAL (Safety latch on)
EMER CAB PRESS vlv - BOTH
CAB REPRESS vlv - OPEN (CW)
MONITOR SURGE TANK PRESS
AT 150 psia on SURGE TANK:
  EMER CAB PRESS vlv - OFF
  CAB REPRESS vlv - Adj to 150 psia on SURGE TANK
WHEN CAB PRESS ≥ 4.7
  CAB FAN (both) - ON
  02 PRESS IND - TANK ;
  CAB REPRESS vlv - CLOSE (CCW)

4 CM 02 SUPPLY REFILL after cabin dump
SURGE TANK PRESS ≥ 500 psia
CAB REPRESS vlv - CLOSE (CCW)
REPRESS 02 vlv - CLOSE
PLSS vlv - FILL
  SURGE TANK PRESS - 865-935 psia
02 PRESS IND - TANK 1
PLSS vlv - OFF

5 02 TOP OFF for ENTRY
SURGE TANK vlv - ON (verify)
REPRESS 02 vlv - ON until:
  TANK PRESS = CRYO PRESS - 50
REPRESS 02 vlv - OFF

SYSTEMS MANAGEMNT

Nov. 6, 1968

Basic Date
Changed

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Nov. 6, 1968

Basic Date
Changed

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WASTE MANAGEMENT PROCEDURES

1 VERIFICATION OF CLEAR URINE VENT LINE
URINE DUMP HTR - ON (verify)
  Waste stowage vent vlv-open 5 sec-then closed
  Batt vent vlv - open
  Systems test ind 4A -
  Monitor Batt Manif Press 0
  Batt Vent vlv - Close
  SYS TEST - 4B if desired
  Pressure not 0 or Decay to 0 -Line not clear-
    Use Side Hatch Water/Urine Dump Procedure
    pg S-15

2 PGA URINE COLL BAG DUMP
  Connect Urine transfer hose & filter
    to urine feces QD.
  Connect urine transfer hose to thigh OP
  Waste mgt drain vlv - dump until bag empty
  Disconnect urine transfer hose from PGA
  Replace cap on PGA
  Install vacuum fit in to UT Hose
  Purge dump line 30 sec
  Waste mgt onbd drain off

3 UTS (Collection)
  Obtain UTS & verify vlv - Closed
  Attach UTS - open vlv - Perform task
  UTS vlv - Closed & disconnect

4 UTS/VACUUM (Dump)
  Verify vent line clear
  Connect UT hose/filter to urine/Feces QD
  Attach UTSVACUUM to hose
  Waste mgt ovbd drain - DUMP
  UTS vlv - OPEN (If UTS DUMP)
  Purge lines 30 sec
  Waste mgt ovbd drain - OFF

5 WASTE WATER TANK DRAIN

Used as req to maintain water level between 25 & 85%
UR DUMP HTR - ON (verify)
Verify Urine Vent Line Clear-(Step 1A Above)

Attach Hose/Filter to Urine/Feces QD
Waste Tank SVC vlv - CLOSED
Remove WASTE TANK SVC PLUG (tool L)
Install Female QD to waste tank SVC port
Attach Hose to QD on Waste Water Panel

Waste Mgt Drain - DUMP
Waste Tank SVC vlv - OPEN
Monitor waste tank decreasing qty
Monitor potable tank quantity stable
At approximately 25% - Waste Tank SVC vlv - CLOSED

Detach UT hose at Waste Tank QD
Install UTS or vacuum fitting on UT hose
Purge 30 sec
Ovbd drain - close
Detach & stow

6 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
Util Pwr - off
Connect cable to utility outlet
Util Pwr - on (wait 1 hr before dumping)
Connect Urine Dump Hose to Dump Nozzle QD
Connect other end of UT hose to UTS/ Waste Servicing Tank (See Step 5 for waste water dump)
Dump Waste Water/Urine
Disconnect UT hose from UTS/Waste Servicing Tank and Purge
Disconnect UT Hose from Dump Hozzle & stow
Util Pwr - off
Disconnect Cable from heater & outlet & stow
Install plug & dump nozzle connector

7 WATER COLLECTION WITH SUIT HOSE

If collecting more than 1/2 pint H20,
remove CO2 Absorber Filter from
canister A (or B) & replace cover.
CO2 Cstr Divert vlv - Both (Ctr)
(until interlock pin is engaged)
CO2 Cstr Divert vlv - A (or B)
(flows through empty canister)
Begin water collection
Monitor part CO2 Press ind -
<7.6mm Hg (during time flow is
through empty canister)
Complete water collection
allow 1 min add flow
Return CO2 absorber canister
to original configuration.

CABIN COLD SOAK

1 ACTIVATE

SUIT HT EXCH SEC GLY vlv - FLOW
EVAP H20 CONT SEC vlv - AUTO
GLY TO RAD SEC vlv - BYPASS
CAB TEMP - MAN
PRIM CAB TEMP vlv - C (CW)
SEC CAB TEMP vlv - OFF (CCW)
SUIT CKT HT EXCH - BYPASS (20sec), then OFF
ECS IND - SEC
SEC COOL LOOP PUMP - AC1
GLY DISCH SEC PRESS - 39-51 psig
SEC ACCUM QTY - 30-55%
SEC COOL LOOP EVAP - EVAP
SEC GLY EVAP OUT TEMP - 40-50.5°F
SEC GLY EVAP STM PRESS -
0.1-0.15 psia, >.16 not boiling
ECS IND - PRIM
PRIM ECS RAD OUT TEMP >-20°F

If <-20°F, deactivate

SYSTEMS MANAGEMENT

Basic Date Changed — Nov. 6, 1968

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Basic Change

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2 DEACTIVATE

SEC CAB TEMP vlv - COOL MAX (CW)
~~PRIM CAB TEMP — AUTO~~
SUIT CKT HT EXCH - ON (20 sec), then OFF
SEC COOL LOOP EVAP - RESET 58 sec, min,
then OFF
SEC COOL LOOP PUMP - OFF
EVAP H20 CONT SEC vlv - OFF (AUTO for ENTRY)

C&WS OPER CK

C/W LAMP TEST - 1 (hold)
M/A Pnl 1 - ON
LH C/W lts (16) - ON
C/W LAMP TEST - 2 (hold)
M/A Pnl 1 - OFF
LH C/W lts (16) - OFF
M/A Pnl 3 - ON
RH C/W lts (23) - ON
C/W LAMP TEST - OFF (lts OFF)
C/W CSM - CM
CM RCS lt (both) - ON
M/A Tone & Lts (3) - ON, RESET
M/A Tone & Lts (3) - OFF
C/W CSM - CSM
CM RCS lts (both) - OFF

SYSTEMS TEST METER READOUTS

Systems Test Meter Display	N_2, O_2, H_2 Pressure (PSIA)	EPS Radiator Outlet Temperature (°F)	CM-RCS Oxidizer Valve Temperature (°F)	LM Power (Amps)	SPS Temperature (°F)	Battery 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	0.72	1.8
0.4	6	-22	-42	0.8	16	1.44	3.6
0.6	9	-8	-38	1.2	24	2.16	5.4
0.8	12	+6	-34	1.6	32	2.88	7.2
1.0	15	+20	-30	2.0	40	3.60	9.0
1.2	18	+34	-26	2.4	48	4.32	10.8
1.4	21	+48	-22	2.8	56	5.04	12.6
1.6	24	+62	-18	3.2	64	5.76	14.4
1.8	27	+76	-14	3.6	72	6.48	16.2
2.0	30	+90	-10	4.0	80	7.20	18.0
2.2	33	+104	-6	4.4	88	7.92	19.8
2.4	36	+118	-4	4.8	96	8.64	21.6
2.6	39	+132	0	5.2	104	9.36	23.4
2.8	42	+146	+4	5.6	112	10.08	25.2
3.0	45	+160	+10	6.0	120	10.80	27.0
3.2	48	+174	+14	6.4	128	11.52	28.8
3.4	51	+188	+18	6.8	136	12.24	30.6
3.6	54	+202	+22	7.2	144	12.96	32.4
3.8	57	+216	+26	7.6	152	13.68	34.2
4.0	60	+230	+30	8.0	160	14.40	36.0
4.2	63	+244	+34	8.4	168	15.12	37.8
4.4	66	+258	+38	8.8	176	15.84	39.6
4.6	69	+272	+42	9.2	184	16.56	41.4
4.8	72	+286	+46	9.6	192	17.28	43.2
5.0	75	+300	+50	10.0	200	18.00	45.0

SYSTEMS MANAGEMNT

103

Basic Date — Nov. 6, 1968
Changed — Nov. 27, 1968

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Basic Date — Nov. 6, 1968
Changed —

TELECOMM PROCEDURES

HI-GAIN ANTENNA OPERATION

cb HI-GAIN ANT FLT BUS - closed
cb HI-GAIN ANT ac GRP 2 - closed
HI-GAIN ANT TRACK - MAN
HI-GAIN ANT SERVO ELEC - PRIM
HI-GAIN ANT BEAM - WIDE
HI-GAIN ANT PWR - POWER
Go to V64 START S-BAND ANTENNA procedures
Verify required coordinates within full coverage region
*If required coordinates are in scan limit zone or skin refelction 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 OMNI - 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

CAUTION

HI-GAIN ANT TRACK-MAN when omni antenna operation is selected to prevent damage to the HGA due to jitter.

S-20

TV CAMERA OPERATION

Unstow camera, lens, and cables
S-BD AUX TV - OFF
Connect power and RF cables
Install proper lens
  (telephoto out of focus at < 143 ft)
  (wide angle out of focus at <18 in)
S-BD AUX TV - TV
ALC (camera) - IN (normally)
  OUT (when detail on dim objects in presence of bright objects is desired)
Power (camera) - ON
When TV operation is completed -
  Power (camera) - OFF
  S-BD AUX TV - off (center)
  Disassemble and stow equipment as desired

Basic Date Nov. 6, 1968
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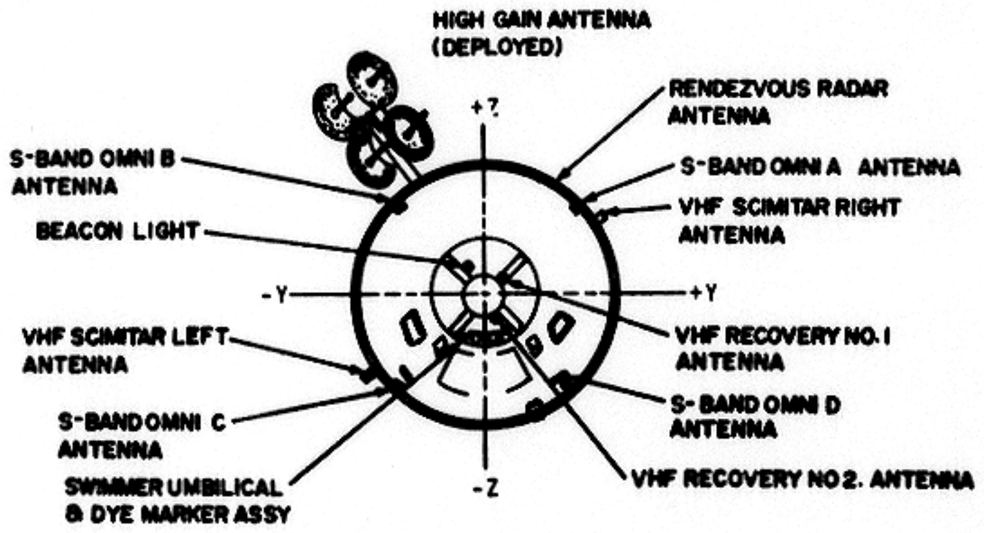
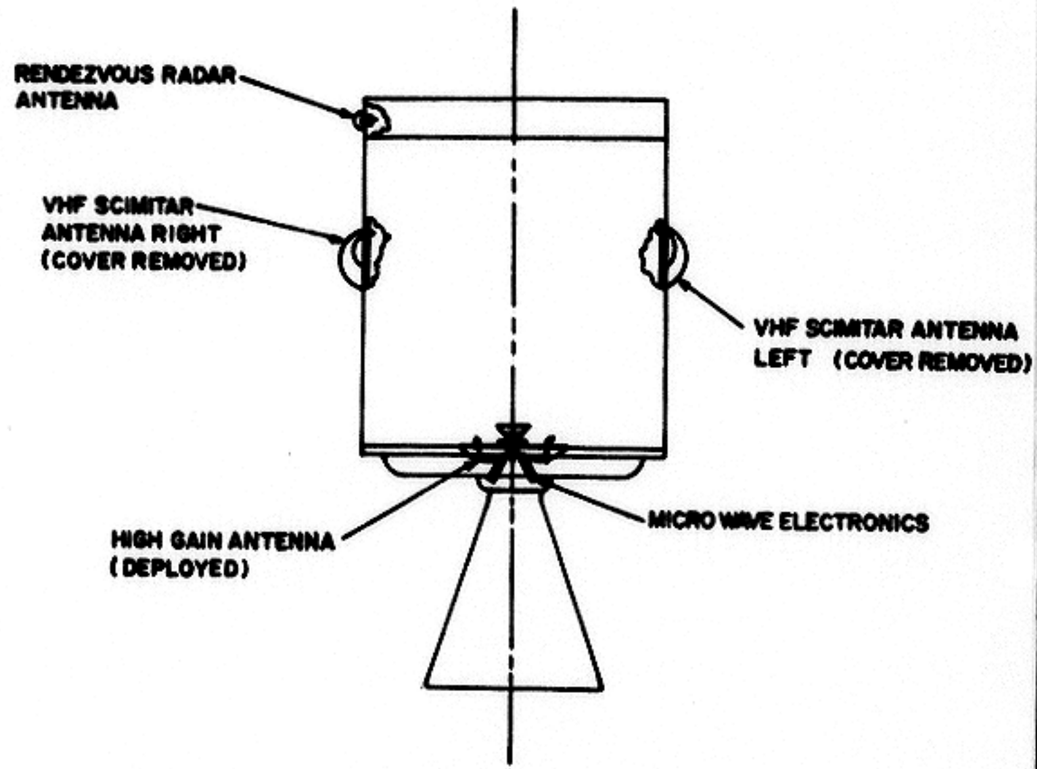
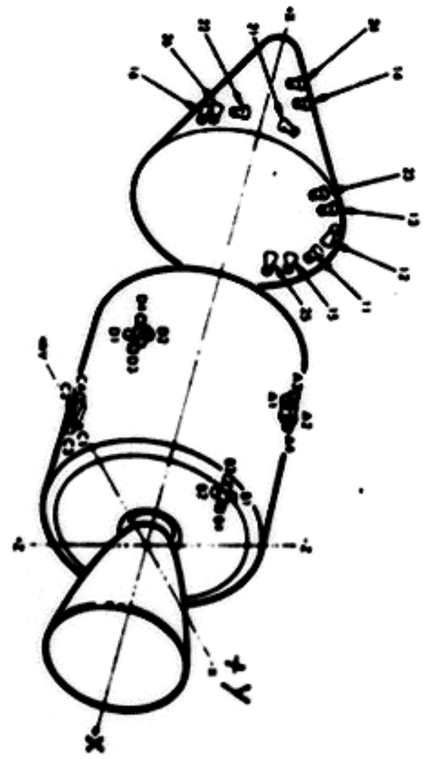
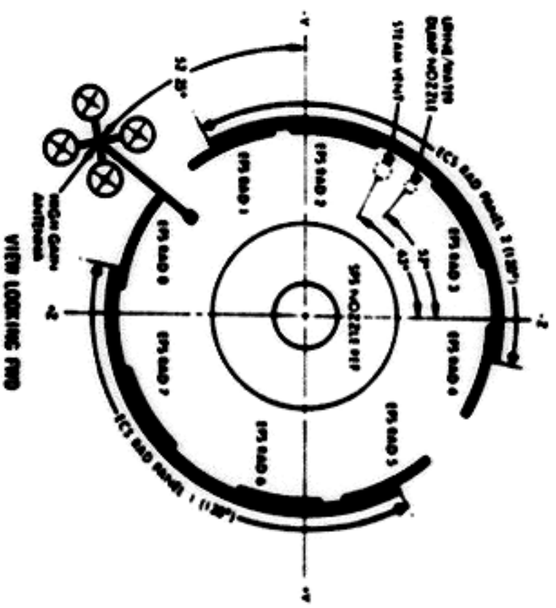
ANTENNA POSITIONS







RCS Engine, Vent, and Radiator Location



RCS ENG VENT

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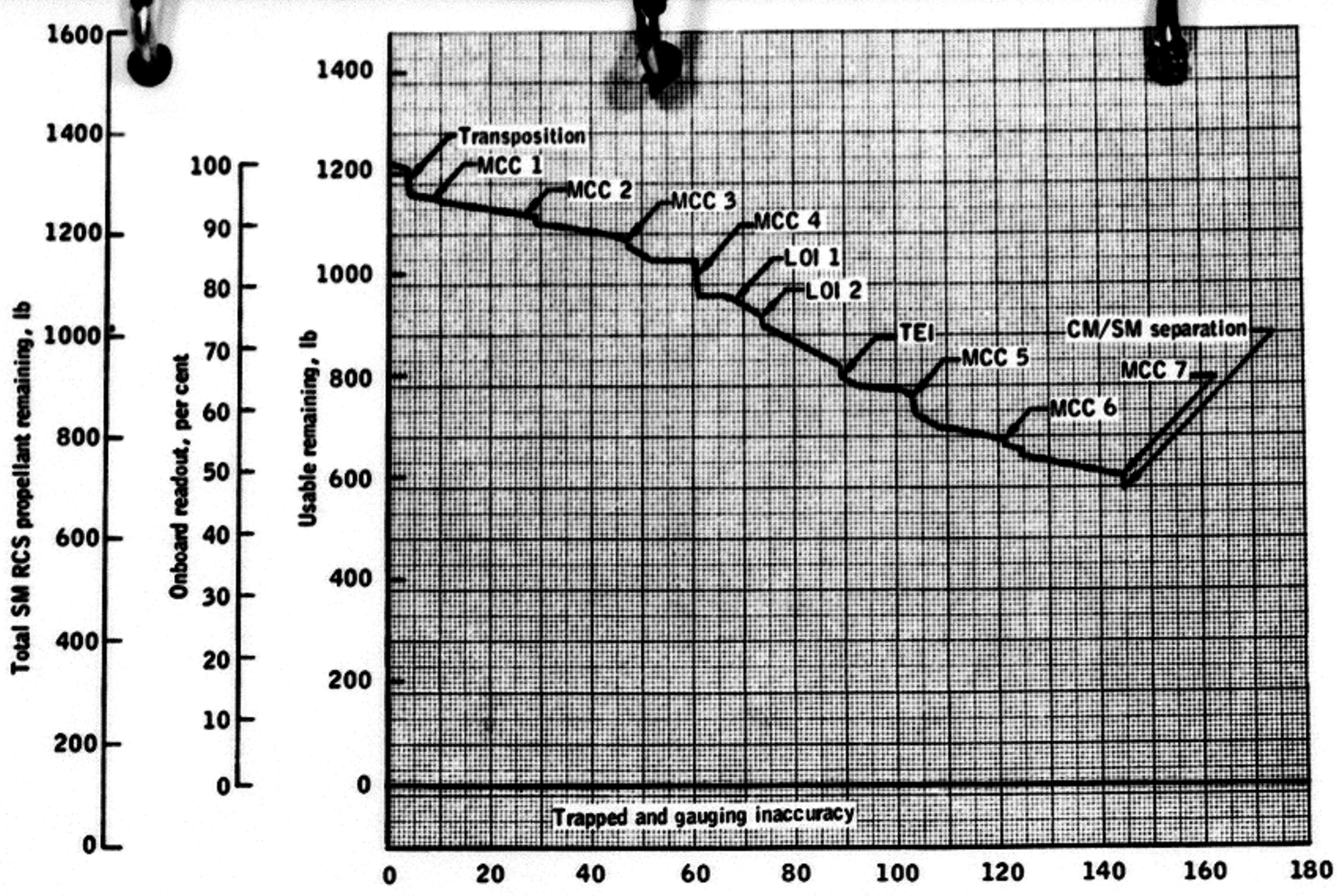

SM RCS propellant profile.

PREDICTED SM-RCS PROPELLANT TRANSLATION COST (CSM-103)

Spacecraft Weight (lbs)	±X 4 Jet PGNCS (lb/fps)	±X 4 Jet SCS (lb/fps)	+X 2 Jet AC PGNCS (lb/fps)	+X 2 Jet AC SCS* (lb/fps)	+X 2 Jet BD PGNCS (lb/fps)	+X 2 Jet BD SCS** (lb/fps)	±Y or ±Z PGNCS (lb/fps)
63600 (Translunar)	7.3	9.1	7.6	9.1	8.0	9.1	9.7
46200 (Lunar Orbit)	5.3	6.4	5.6	6.4	5.7	6.5	6.5
32200 (Transearth)	3.6	4.3	3.5	4.3	4.0	4.3	4.2

*Jets 3 and 4 disabled (A3, C4)

**Jets 7 and 8 disabled (B3, D4)

Minimum impulse control ≈ 0.005 lb/pulse

EMERGENCY PROCEDURES

FIRE/SMOKE IN CM (CREW SUITED)

1 CAB FAN (both) - OFF

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

3 Verify suit compressor on good AC BUS

4 Use fire extinguisher as appropriate

FIRE IS OUT

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

FIRE PERSISTS - DUMP CABIN

6 Verify:
- SUIT CKT RET vlv - PUSH TO CLOSE
- EMER CAB PRESS vlv - OFF
- O2 PLSS vlv - OFF

7 Visually check suit integrity

8 CAB PRESS RELF (RH) - DUMP to 3.0 psia
then to BOOST ENTRY

REMARK: Provides controlled cabin dump until suit circuit pressure is verified

9 Verify Suit pressure > 3.5 psia

10 CAB PRESS RELF (RH) - DUMP
and/or Hatch Vent vlv - open

11 CAB PRESS ind 0.0 psia for 6 min

12 CAB PRESS RELF (RH) - NORMAL

13 Hatch Vent vlv - close

14 Do not repress cabin until fire source is removed

FIRE/SMOKE IN CM (CREW UNSUITED)

1 CAB FAN (both) - OFF

2 SUIT COMPR (both) - OFF

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

4 Don emergency 02 masks

5 Use fire extinguishers as appropriate

FIRE IS OUT

6 Remove smoke from cabin per "Contamination in CM" procedure before removing 02 masks

FIRE PERSISTS - DON SUITS and DUMP CABIN

7 Don PGA's except helmets and verify 02 connectors (Use 02 masks as long as possible)

8 DIRECT 02 vlv - OPEN (CCW)
REMARK: Purges suit circuit of smoke and fumes

9 Don helmet

10 Suit flow vlv (3) - SUIT FULL FLOW

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

12 DIRECT 02 vlv - CLOSE (CW)

13 EMER CAB PRESS vlv - OFF

14 Visually check suit integrity

15 CAB PRESS RELF (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 Hatch Vent vlv - open

18 CAB PRESS ind 0.0 psia for 6 min.

19 CAB PRESS RELF (RH) - NORMAL

20 Hatch Vent vlv - close

21 Do not repress cabin until fire source is removed

Basic Date Nov. 6, 1968
Changed

SYSTEMS MANAGEMENT

EMERGENCY

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> 0.38 psi.

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 (CCW) for 1 minute then close (CW)

If condition persists:

4 SUIT COMPR 2 - OFF

5 DIRECT O2 vlv - OFF

6 Doff helmet

7 Don emergency O2 masks

Nov. 6, 1968

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Changed - Dec. 17, 1968

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EMERGENCY POWER DOWN

NOTE: Use only after FC or BATT loss, no short verified, & main bus voltage < 26.0 VDC.

Powerdown the following components until bus voltage ≥26.5 VDC:

O2 HTRS(both)-OFF	11.0amps
NONESS BUS-OFF	4.9
FLT QUAL RCDR-OFF	.74
GMBL MTRS(4) - OFF/ON	20.0
MN A&B BAT C cb(both)-Close	-
ECS RAD HTRS PRIM & SEC-OFF	17.3
FC PUMPS (3)-OFF	3.0ea
SM RCS HTRS A,B,C&D-OFF	2.86ea
POT H2O HTR-OFF	1.6
H2 HTRS (both)-OFF	1.44
CAB FANS(both)-OFF	1.94
SPS LINE HTR-OFF	1.03ea
LIGHTS - Min reqd	-
CMC To STBY	
V48E	
F04 46 Load 0 Left digit R1	
PRO,PRO,PRO, V46E	
F 50 25 00062 CMC PWR ON	
PRO-HOLD until STBY Lt On	
G&N PWR DN (STBY)	
CMC MODE - FREE	
G&N IMU PWR-OFF	
S-Bd PWR AMP-OFF	3.53
TAPE RCDR-OFF	
GLY/EVAP STM PRESS-MAN	
STM PRESS-INCR(58sec)	
H2O FLOW-OFF.	
TEMP IN-MAN	2.77ea
ECS GLY PUMPS - OFF	
SEC COOL LOOP EVAP -RESET(58sec)	
PUMP -OFF	2.69
ECS RAD CONT/HTR cb(both)-OPEN	

EMERGENCY POWER DOWN (CONT)

PWR SCE-OFF	.65
VHF(both)-OFF	
HGA PWR-OFF	
TELECOM GRP 1&2	
CONFIG for single inverter-Open	
INSTRUM ESS MN A&B cb(both)OPEN	5.54
SUIT COMPR(both)-OFF	
DIR O2-ON(If Suited)	-

UNACCEPTABLE VEHICLE DYNAMICS DURING CRITICAL SPS THRUSTING

1 THC - CW
2 DAMP RATES USING RATE NEEDLES
3 CHECK FDAI #1 ATTITUDE: If attitude and error needles are not steady use FDAI #2 to return to desired burn attitude.
4 If above fails - with small divergence attempt rolling vehicle to cancel errors.

PREMATURE SPS SHUTDOWN DURING CRITICAL BURN

1 SPS THRUST DIRECT SW - ON
2 CHECK ΔV THRUST A/B - ON
3 CHECK SPS PILOT vlvs and SPS Helium vlv CB's CLOSED (PNL 8)
4 CHECK EPS GRP 3 & 5 CB's CLOSED (PNL 229)
5 FCSM (2) - RESET/OVERRIDE
6 SPS He vlv (2) - ON
7 S/C CONT - SCS
8 SCS TVC - AUTO
9 THRUST - ON

SPS ENGINE DOES NOT SHUTDOWN AUTOMATICALLY

1 ΔV THRUST A/B - OFF
2 THC - CW
3 CHECK SPS DIRECT ON - OFF
4 SPS PILOT vlv (2) CB's - OPEN (PNL 8)
5 EPS Group 5 CB's - OPEN (PNL 229)

SYSTEMS MANAGEMENT

Nov. 6, 1968
Dec. 17, 1968
Basic Data
Changed

SPS FLANGE TEMP LIGHT DURING LOI$_1$ BURN

1 If <120 sec, shutdown and perform Mode I 15 min abort
2 If >120 sec, shutdown

SPS PRESSURE LIGHT ON DURING CRITICAL BURN

1 Pressure high - SPS He vlv (2) - OFF
2 Pressure low
  a. SPS He vlv (2) - ON
  b. If pressure does not increase - Except during TEI

SM RCS THRUSTER FAILED - ON

1 SC CONT to Alternate Source
2 ROT CONTR PWR DIRECT(both)-MN A/B (Control Rates In Direct)
3 AUTO RCS SEL - OFF (In Affected Axis)
4 DIRECT Ullage cb(both)- Open
5 If vehicle rates are still uncontrolled:
  a. AUTO RCS SEL (16) - ON
  b. MAN ATT(3)-ACCEL CMD
  c. ROT CONTR PWR DIRECT (both)-OFF
6 If rates are still uncontrolled:
  SM RCS Prplnt - OFF

FC 1(2)(3) LIGHT ON DUE TO PH Hi tb-bp

1 FC 1(2)(3) PUMPS - OFF
2 POTABLE TANK INLET vlv - CLOSE

MN BUS A(B) UNDERVOLT LIGHT ON

1 Check pertinent bus voltage
2 If only one bus low and high current isolate & reconfig
3 If both busses low use powerdown cklist, pg 5 EMG-5.

AC BUS 1(2) LIGHT ON WITH MN BUS A(B) UNDERVOLT AND/OR BUS 1(2) OVERLOAD

Turn OFF associated inverter within 5 sec

CABIN PRESSURE <5psia AND DECREASING

1 CABIN PRESSURE REL v1v(both)-CLOSED
2 Don PGA's - unstow O_2 masks if not 100% O_2 atmosphere

O_2 Hi LIGHT ON - CABIN PRESSURE NORMAL OR HIGH

1 Check O_2 flow ind - if not pegged isolate C&W or ind failure by turning on DIRECT O_2 valve moment.
2 If O_2 flow ind is pegged, check for low surge tank press. If cryo tank - surge tank ΔP <50psi the flow sensor has failed
3 With low surge tank - MAIN REG A&B-CLOSED

SUIT COMPRESSOR FAILS WHILE SUITED

1 Select redund suit compr on alt AC bus
2 At critical time turn on DIRECT O_2 valve
3 When feasible, remove helmets

H_2 or O_2 FC FLOW HIGH

1 Check O_2 & H_2 Flow Rates
2 If one is High, cycle approp purge valve several times
CAUTION: If H_2 flow is high turn on H_2 purge line htr before cycling purge valve

PRIM EVAP OUT TEMP HIGH (APPROACHING 60°)

1 ECS IND SEL - SEC
2 SEC COOL LOOP PUMP - AC1 or AC2
3 SEC COOL LOOP EVAP Sw - EVAP

Basic Date
Nov. 6, 1968
Rev. 17 1968