APOLLO 11	
OPERATIONS CHECKLIST	
PART NO	S/N
SKB32100080-307	100

INTERESTING PICTURES: (SELECTED IN LRL)

AS11-44-6609 BACKSIDE PANORAMA
" 37-5445 BEST 70MM OF COLUMBIA
" 36-5295 EPO · STORM
" 36-5355 4/5 EARTH, GOOD OF AFRICA, SO EUROPE, & USSR
" 36-5337 " ALL CLOUDS & WATER
" 40-5899 BEST OF THE "HERE MEN..."
" 44-6642 "EAGLE" AGAINST MOON BACKGROUND W EARTH RISING

S-69-40220 3 CREW THRU MQF WINDOW (EFD)
" 40216 LRL DEBRIEF

AS11-37-5437 APPROACH TO LAND SITE 2
40-5902 FOOTPAD + BUZZ
40-5903 BUZZ HEAD-ON, REFLECTIONS IN VISOR
40-5868 " COMING DOWN LADDER
40-5880 FOOT LIFTED UP, SHOWING PRINT.
37-5478 DOWN SUN WASHOUT, LM SHADOW
40-5949 THE WHOLE SURFACE SHEEBANG.
37-5481 RCS QUAD SHOW, FLAG, TV CAMERA, ROCK FIELD
40-5874 BUZZ SALUTING FLAG
40-5851 SURFACE, ROCKS + CRATERS

CMP

FLIGHT TABLE OF CONTENTS

Basic Date — April 15, 1969
Changed — June 27, 1969

CSM 1 & SUBS

Basic Date April 15, 1969
Changed June 27, 1969

CSM 1 & SUBS

Basic Date April 15, 1969
Changed June 27, 1969

Basic Date — April 15, 1969
Changed — June 27, 1969

CSM 7 & SUBS

Basic Date April 15, 1969
Changed June 6, 1969

[redacted] SPS BURNS $\Delta V_{TPF} = 32.3$ D

↓ [FOR SCS,S/C CONT-SCS MNVR TO PAD R, P Y,-UNCAGE BMAGS]

G&N: LOAD DAP (P TRIM____Y TRIM____)(B&D for 2 JET ULLAGE)

[redacted]

P3X CONFIRM TIG & ΔV, SET EVENT TIMER
P40: F50 18-CAGE BMAGS-CMC-AUTO
PRO TO MNVR: BORESIGHT & SXT STAR CK
EMS ΔV CK 1586.8, SET ΔV_C, FUNC ΔV & STBY
ΔVcg: CSM OR CSM/LM
AUTO RCS SEL (16) AS REQ'D (SAME ROLL AS DAP)
PNL 8: SCS & SPS CB CLOSED

[redacted]

MAN ATT (3) - RATE CMD
LIMIT CYCLE, D/B - MIN, RATE - HI, [redacted] THC PWR-ON
SCS TVC (2) - RATE CMD, TVC GMBL DR (2)-AUTO
ALIGN GDC - HE VALVES AUTO(B/P)

[redacted]

54:00 MN BUS TIES - ON
TVC SERVO PWR 1 & 2 ON
ROT CONT PWR NORM # 2-AC ↓
ROT CONT #2-ARMED

55:00 GIMBAL MTRS - P1 & Y1 START
THC - CW (VERIFY NO MTVC)
P2 & Y2 - SET TRIM
VERIFY MTVC - THC NEUTRAL
VERIFY GP1=0 (CMC) OR TRIM (SCS)
ROT CONT PWR NORM # 2 - AC/DC
[FOR SCS BURNS, S/C CONT-SCS]
[FOR SCS BURNS, SCS TVS (2)-AUTO]
ROT CONT PWR DIR #2 - MNA/MNB
RECHECK BORESIGHT STAR
PRO TO TRIM ATTITUDE - ENTER
F50 25 (204) PRO GIMBAL DR CK
UNCAGE BMAGS

AOS 135:34:05
26370

[redacted]

58:00 ΔV THRUST NORM (A FOR ALL BUT LOI_1)
THC - ARMED, EMS ΔV - NORM

[redacted]

OK

59:30 TAPE-RECORD, HBR, FWD
ULLAGE - PRO AT F99 → 2 JET: LOI_2=:19
[SCS-THRUST ON P/B] TEI =:16
TIG NOTE TIME MCC =:12
ΔV THRUST NORM - OTHER BANK ON
SHUTDOWN: (FOR B/T >:06)
ΔV THRUST NORM - 2 OFF
CB SPS P 2 & Y 2 - CLOSED
GIMBAL MTRS - CONFIRM 4 OFF
TVC SERVO PWR (2) OFF
CAGE BMAGS

RESIDUALS: RECORD AND NULL X-AXIS TO 1.0 FPS (EXCEPT .2 TEI)
EMS: NOTE ΔVC- TURN OFF
THC PWR - OFF,ROT CONT PWR DIR-OFF
LIMIT CYCLE - ON,RHC&THC-LOCKED
TAPE - LBR
BUS TIES - OFF

FAILURE PROCEDURES:

	G&N BURN	SCS BURN
AC BUS 1 OR MN BUS A UNDERVOLT	TVC GIMBAL DR↓↓ FDAI SEL - #2	THC
AC BUS 2 MNB BUS B UNDERVOLT	TVC GIMBAL DR↑↑ BMAG MODE (3) RATE 1 PULL CB SPS P1-Y1	STEER W/THUMBWHEEL OR SHUTDOWN
GIMBAL HARDOVER	THC	THC
#1 BMAG FAIL		THC
#2 BMAG FAIL	BMAG RATE 1	BMAG RATE 1
SPS PRESS	CK FUEL/OX PRESS CK HE VALVES OPN	CK RUEL/OR PRESS CK HE VALVES OPEN

Ok
me

D

P22 (LM ATTACHED)
A-1 LAT +02.000 APPROACH R 0 (INRTL)
LONG/2 +32.750 P ~~297~~ 303
ALT +000.00 Y 0 "
NORTH OF TRACK ~~14.1~~ 7 NM

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

T1 82:37:35
PITCH-ACCEL CMD
T2 82:42:50 (MARK :40 SEC LATER)
RECORD 06 89 +02009, +32594, -00177
STOP PITCH AT SLEEP ATT (R-82, P-229, Y-0)

DAP ok-ly at 218° P LIKE EMS

P22 (LM ATTACHED) 43
130 LAT +01.266 APPROACH R 0 (INRTL)
LONG/2 +11.839 44 P ~~290~~ 270
ALT -001.88 46 Y 0 "
NORTH OF TRACK ~~+5.8~~ 4 NM

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

1/2 PITCH AUTHORITY

37:35
T1 98:40:02
PITCH-ACCEL CMD
T2 98:42:44 (MARK :40 SEC LATER)
RECORD 06 89 +01444, +11817, -00139
STOP PITCH AT REACQUIRE MSFN ATT (R-0, P-~~3~~ 22.5, Y-0)

MARK 98:43:24

P22 (CSM ONLY) +
LM LAT +00.7~~14~~ 99 NOTE: SCS MIN IMP
LONG/2 +11.~~854~~ 730 4 PULSES=.05°/SEC
ALT -001.51
SOUTH OF TRACK 0.2 NM
104:32:18 V48E CONFIRM R1 = 11100 (FDAI #2 θ = 338°)
104:37:28 MNVR TO +X 22° BELOW HORIZONTAL (2° Below HORIZON)
V49E, V25E, ______, ______, ______ PRO
~~4~~ 5 CMC MODE - FREE
2 V37E 22E 24
T1 104:32:~~18~~ T2 104:37:~~28~~ 33 (MARK :40 SEC LATER)
CMC MODE - HOLD
RECORD 06 89 +00776, +11693, -00155

START MARKS AT 104:38:08
START DET

TCA 108:35
T1 112:25
T2 112:30:17
45

SOURCE
DATE

ENTRY PAD

OL
MC

HORIZON CK (EI-17:00)
GET 194 :46: 06
PITCH 267° (+5°)
05g 000, 152, 001
(HORIZ 34°) R P Y
RRT 195 :03:06 (400K)
RET 05g:28
RET VCIRC 2:14
RET DROGUE 9:02

EI (400K)
- Pitch Needle Off Peg
- Vi Dsky=Vi PAD
- Event Timer Zero

.05g
- START EMS (:03)
- TRANSFER P64 (:05)
- PITCH NEEDLE 0°
- PITCH ANGLE 152° ±5°
- HORIZON 34°
- RGO DSKY=RGO PAD

BETA 90° UNTIL <5.4g
180° TO 4-5g

RETCIRC VS VDSKY VS VEMS
EMS 26nm @4000FPS (0@DRO)

ELS Cbs, LOGIC, AUTO
PYROS

HORNET
RECOVERY 1
HAWAII RESCUE 1 & 2
(C-130)

P61

F 06 61	IMP LAT	.01°	E
	IMP LONG	.01°	
PRO	HDS UP/DN	±00001	
F 06 60	GMAX	.01G	
	V400K	fps	
PRO	γ EI	.01°	
F 06 63	RTOGO	.1 nm	
	VIO	fps	
PRO	TFE	min-sec	

P62

F 50 25	00041 REQ SEP	
PRO		
F 06 61	IMP LAT	.01° +01332
	IMP LONG	.01° -16917
PRO	HDS DN	-00001
06 22	Poss R	.01°
	P	.01°
	Y	.01°

P63

06 64	G	.01G
	VI	fps
	RTOGO	.1 nm

P64

	.05 LT, EMS START	
	*No EMS 3 sec: *	
	*EMS-MAN *	
F 06 74	BETA	.01°
	VI	fps
	G	.01

P65

F 16 69	BETA	.01°
	DL	.01G
	VL	fps
06 74	BETA, VI, G	

P66

06 22 R,P,Y

P67

06 66	BETA	.01°
	CR ERR	.1 nm
VERB	DR ERR	.1 nm
Record	DR ERR	
	KEY RLSE	
F 16 67	RTOGO	.1 nm
	LAT	.01°
	LONG	.01°

SECTION 1. REFERENCE DATA

STAR LIST

NO	STAR NAME (Numerical)	STAR NAME (Alphabetical)	NO
00	Planet	Acamar	6
1	Alpheratz	Achernar	4
2	Diphda	Acrux	25
3	Navi	Aldebaran	11
4	Achernar	Alkaid	27
5	Polaris	Alphard	21
6	Acamar	Alphecca	32
7	Menkar	Alpheratz	1
10	Mirfak	Altair	40
11	Aldebaran	Antares	33
12	Rigel	Arcturus	31
13	Capella	Atria	34
14	Canopus	Canopus	14
15	Sirius	Capella	13
16	Procyon	Dabih	41
17	Regor	Deneb	43
20	Dnoces	Denebola	23
21	Alphard	Diphda	2
22	Regulus	Dnoces	20
23	Denebola	Earth	47
24	Gienah	Enif	44
25	Acrux	Fomalhaut	45
26	Spica	Gienah	24
27	Alkaid	Menkar	7
30	Menkent	Menkent	30
31	Arcturus	Mirfak	10
32	Alphecca	Moon	50
33	Antares	Navi	3
34	Atria	Nunki	37
35	Rasalhague	Peacock	42
36	Vega	Planet	00
37	Nunki	Polaris	5
40	Altair	Procyon	16
41	Dabih	Rasalhague	35
42	Peacock	Regor	17
43	Deneb	Regulus	22

CSM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

44	Enif	Rigel	12
45	Fomalhaut	Sirius	15
46	Sun	Spica	26
47	Earth	Sun	46
50	Moon	Vega	36

VERB LIST (Decimal)

01	Display Oct Compnt 1 (R1)
02	Display Oct Compnt 2 (R1)
03	Display Oct Compnt 3 (R1)
04	Display Oct Compnt 1, 2 (R1, R2)
05	Display Oct Compnt 1, 2, 3 (R1,R2,R3)
06	Display Decimal (R1 or R1, R2 or R1,R2,R3)
07	Display DP Decimal - (R1,R2)
11	Monitor Oct Compnt 1 (R1)
12	Monitor Oct Compnt 2 (R1)
13	Monitor Oct Compnt 3 (R1)
14	Monitor Oct Compnt 1, 2 (R1, R2)
15	Monitor Oct Compnt 1, 2, 3 (R1,R2,R3)
16	Monitor Decimal (R1 or R1,R2 or R1,R2,R3)
17	Monitor DP Decimal - (R1,R2)
21	Load Compnt 1 (R1)
22	Load Compnt 2 (R2)
23	Load Compnt 3 (R3)
24	Load Compnt 1, 2 (R1, R2)
25	Load Compnt 1, 2, 3 (R1, R2, R3)
27	Display Fixed Memory
30	Request Executive
31	Request Waitlist
32	Recycle Prog
33	Proceed Without DSKY inputs
34	Terminate Function
35	Test Lights
36	Request Fresh Start
37	Change Prog (Major Mode)
*40	Zero ICDU (N20)
41	Coarse Align CDU (N20 & N91)
42	Fine Align IMU
43	Load FDAI ATT Error needles
*44	Set Surface Flag
*45	Reset Surface Flag
*46	Activate DAP

Basic Date April 15, 1969
Changed June 1, 1969
107 & SUBS

*47 Set LM State Vector into CSM State Vector
 48 Load DAP (R03)
 49 Start Crew Defined MNVR(R62)
 50 Please Perform
 51 Please Mark
*52 Marked on offset landing site
 53 Please Mark alternate LOS
 54 Start REND backup sighting mark (R23)
 55 Increment CMC Time (Decimal)
*56 Terminate Tracking (P20)
 57 Start REND sighting mark (R21)
*58 Reset Stick Flag
 59 Please Calibrate
*60 Set N17 = N20
*61 Display DAP att error
*62 Display total att error (N22-N20)
*63 Display total astro att error (N17-N20)
 64 Start S-band ant routine (R05)
*65 Verify Prelaunch Align Optics (CSM)
*66 Set CSM State Vector into LM State Vector
 67 W-Matrix RSS Error Display
*68 CSM Stroke Test on (LM on only)
*69 Restart
 70 Update Liftoff Time (P27)
 71 Univ Update-BLOCK ADR (P27)
 72 Univ Update-SINGLE ADR (P27)
 73 Update CMC Time (Octal) (P27)
*74 Initialize erasable dump via downlink
*75 Backup Liftoff
*76 Set preferred att flag (pref track axis)
*77 Reset preferred att flag (X axis)
*78 Update prelaunch azimuth
*80 Update LM State Vector
*81 Update CSM State Vector
 82 Start Orbit Param Disp (R30)
 83 Start REND Param Display (R31)
 85 Start REND Param Display No.2 (R34)
*86 Reject REND backup sighting mark
*87 Set VHF range flag
*88 Reset VHF range flag
 89 Start REND Final ATT Routine (R63)
 90 Request REND out of plane display (R36)

CSM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

91 Compute Banksum
*92 Start IMU performance test (P07)
*93 Enable W matrix initialization
*94 Enable CISLUNAR Tracking recycle
*96 Terminate integration and go to P00
(Select P00 by V37 after use of V96)
97 SPS Thrust Fail (R40)
99 Enable engine ignition
*Callable with other extended verb in use and does not lock out other extended verbs

NOUN LIST (Decimal)

01	Specify Machine Address (Fract) (R1,R2,R3)	.XXXXX
02	Specify Machine Address (Whole) (R1,R2,R3)	
03	Specify Machine Address (can be R1,R2,R3)	.01°
05	Angular Error/Diff	.01°
06	Option Code (R1 & R2)	OCTAL
07	FLAGWORD operator,ECADR,BIT ID, Action	
08	Add +1 of error	OCTAL
	B BANK + SUPERBANK	OCTAL
	No of SELF TEST errors	OCTAL
09	Alarm Codes	OCTAL
10	Channel to be Specified (R1)	OCTAL
11	TIG (CSI)	hrs,min,.01sec
12	Option code (R1&R2)	OCTAL
13	TIG (CDH)	hrs,min,.01sec
15	Increment Machine Address (R1)	OCTAL
16	Time of event	hrs,min,.01sec
17	Astronaut total att	R,P,Y .01°
18	Auto Maneuver	R,P,Y .01°
20	Present ICDU Angles	R,P,Y .01°
21	PIPA PULSES X,Y,Z	Pulses
22	New ICDU Angles	R,P,Y .01°
24	Delta CMC Clock Time	hrs,min,.01sec
25	Checklist (please perform)	
26	Prio/Delay, ADRES, BBCON(R1,R2 & R3)	OCTAL

Basic Date April 15, 1969
Changed June 1, 1969

[107 & SUBS

27	Self-Test on/off sw	
29	X SM LAUNCH Azimuth	.01°
30	Target Code(Gyrocomp verif)	
32	Time from Perigee	hrs,min,.01sec
33	Time of Ignition (GETI)	hrs,min,.01sec
34	Time of Event	hrs,min,.01sec
35	Time from Event	hrs,min,.01sec
36	Time of CMC Clock	hrs,min,.01sec
37	GETI-TPI	hrs,min,.01sec
38	State Vector Time	hrs,min,.01sec
39	Δ Time of Transfer	hrs,min,.01sec
40	TF GETI/TFC	min-sec
	VG	.1 FPS
	ΔV (Accumulated)	.1 FPS
41	Target	Azimuth .01°
		Elevation .001°
		Ident 0000X
42	Apogee Alt (HA)	.1 NM
	Perigee Alt (HP)	.1 NM
	ΔV (Required)	.1 FPS
43	Lat	.01°
		(+ North)
	Long	.01°
		(+ East)
	Alt	.1 NM
44	Apogee Alt (HA)	.1 NM
	Perigee Alt (HP)(N50)	.1 NM
	TFF	min-sec
45	Marks	XXBXX
	TF GETI of next burn	min-sec
	MGA	.01°
46	DAP Config (R1&R2)	OCTAL
47	CSM weight	LBS
	LM Weight	LBS
48	Pitch Trim	.01°
	Yaw Trim	.01°
49	ΔR	.1 NM
	ΔV	.1 FPS
	SOURCE CODE (1 optics,2 VHF)	0000X.

Basic Date April 15, 1969
Changed June 27, 1969

CSM 107 & SUBS

50	ΔR (miss distance)	.1 NM
	PERIGEE (HP)	.1 NM
	TFF	min-sec
51	RHO	.01°
	GAMMA	.01°
52	CENTANG (active veh)	.01°
53	RANGE	.01 NM
	RANGE RATE	.1 FPS
	PHI (lcl horiz)	.01°
54	Range	.01 NM
	Range Rate	.1 FPS
	Theta (lcl horiz)	.01°
55	Perigee code	CODE
	E(ELEV ANGLE)	.01°
	CENTANG (passive veh)	.01°
57	ΔR offset (SOR) (+ indicates behind target)	.1 NM
58	HP alt (post TPI)(SOR for P38)	.1 NM
	ΔV (TPI)(SOR for P38)	.1 FPS
	ΔV (TPF)(SOR FINAL for P38)	.1 FPS
59	ΔV LOS 1	.1 FPS
	ΔV LOS 2	.1 FPS
	ΔV LOS 3	.1 FPS
60	G Max	.01 G
	V Pred	FPS
	Gamma EI	.01°
61	Impact Lat	.01° (+ North)
	Impact Long	.01° (+ East)
	Head Up/Down	+/-00001 (+ Heads up)
62	VI-Inertial Vel Mag	FPS
	H Dot-Alt Rate	FPS
	H-Alt	.1 NM
63	RTGO from 0.05 G To Splash	.1 NM
	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

SM 107 & SUBS

Basic Date — April 15, 1969
Changed — June 27, 1969

65	Sampled CMC Time (fetched in interrupt)	hrs,min,.01 sec
66	Beta, CMD Bank Angle	.01°
	CRSRNG Error	.1 NM
	DNRNG Error	.1 NM
67	RTOGO to Target	.1 NM
	Lat, Present Position	.01° (+ North)
	Long, Present Position	.01° (+ East)
68	Beta, CMD Bank Angle	.01°
	VI, Inertial Vel.	FPS
	H Dot, Alt Rate	FPS
69	Beta	.01°
	DL	.01 G
	VL	FPS
70	Star Code(before mark)	OCTAL
	LMK Data	OCTAL
	Horiz data	OCTAL
71	Star code (after mark)	OCTAL
	LMK Data	OCTAL
	Horiz data	OCTAL
72	Δ ang	.01°
	Δ alt	.1 NM
	Search option	
73	ALT (P21)	10 NM
	VEL (P21)	FPS
	GAMMA (P21)	.01°
74	BETA, CMD Bank, Angle	.01°
	VI, INERTIAL VELOCITY	FPS
	DRAG ACCELERATION	.01 G
75	ΔH (CDH)	.1 NM
	ΔT	min-sec
	ΔT	min-sec
80	TF GETI/TFC	min-sec
	VG	FPS
	ΔV (Accumulated)	FPS
81	ΔVX,Y,Z (lcl vert)	.1 FPS
82	ΔVX,Y,Z (LV) CDH	.1 FPS
83	ΔVX,Y,Z (Body Control Axis)	.1 FPS
84	ΔVX,Y,Z (Other Vehicle)	.1 FPS
85	VGX,Y,Z (Body Control Axis)	.1 FPS
87	Opt Calib Data - Shaft (R1)	.01°
	Trunnion(R2)	.001°

Basic Date ~~APRIL 15~~, 1969
Changed JUL 27, 1969

CSM 107 & SUBS

ALARM CODES

88	Planet	X	.XXXXX
		Y	.XXXXX
		Z	.XXXXX
89	Landmark - Lat		.001° (+ North)
	Long/2		.001° (+ East)
	Alt		.01 NM
90	REND out of	Y	.01 NM
	Plane para	Y DOT	.1 FPS
		PSI	.01°
91	OCDU Angles Shaft (R1)		.01°
	Trunnion (R2)		.001°
92	New OCDU Angles Shaft (R1)		.01°
	Trunnion (R2)		.001°
93	Delta Gyro Angles X,Y,Z		.001°
94	OCDU ANGLES (R56 & R23)		
		R1 SHAFT	.01°
		R2 TRUNNION	.001°
95	Pref att ICDU angles		.01°
96	+X axis att ICDU angles		.01°
97	System Test Inputs		XXXXX.
			XXXXX.
			XXXXX.
98	System Test Results		XXXXX.
			.XXXXX
			XXXXX.
99	POS ERR		1 FT
	VEL ERR		.1 FPS
	OPTION Code		0000X

V05 N09 ALARM CODES

00110 Mark reject has been entered but ignored
Continue

00112 Mark reject with no marks being accepted
Continue

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

00114 More marks made than desired
Continue

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

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

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

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

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

00122 Marking not called for
Continue.

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

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

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

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

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

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

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

CSM 107 & SUBS Basic Date APRIL 15, 1969
Changed JUNE , 1969

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

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

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

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

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

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

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

00406 Rend navigation not operating
Select P20 or continue.

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

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

**00430 Orbital integration has been terminated to avoid possible infinite loop.
Notify MSFN.
Probable S.V. uplink required

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

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

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

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

Basic Date APRIL 5, 1969
Changed JUNE 6, 1969

CSM 1[illegible] & SUBS

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

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

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

**00607 No solution to conic subroutine
Reselect program.

**00610 Alt at specified TIG in P37 < ∿400K ft
Reselect P37 and decrease TIG.

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

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

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

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

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

**01103 Unused CCS branch executed
Copy N08, notify MSFN, initiate V36 recovery

*01104 Delay routine busy
Reselect extended verb or continue with program.
Notify MSFN.

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

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

(m)01107 Phase table failure-assume erasable memory is destroyed
If Comm: 1. V74 CMC DOWNLINK
2. P27 As Necessary.
3. V48 As Necessary (V46).

4. Reestablish REFSMMAT via
P51 As Necessary.
If FRESH START recurs, CMC FAILURE
(SSR-3).

If no Comm, pg F/2-19

*01201 Executive overflow - no vac. area
Reselect Extended Verb and/or Continue Program.

*01202 Executive overflow - no core sets
See 01201

*01203 Waitlist overflow - too many tasks
See 01201

**01204 Negative or zero time waitlist call
If ave-g on, continue.
Otherwise reselect program.

**01206 Second job attempts to go to sleep via keyboard and display program
See 01204.

*01207 No vac area for marks
Rset
Reselect program
If alarm recurs, consult MSFN.

**01210 Second attempt is made to stall
Reselect program
Do not attempt use of device while CMC is using it.

*01211 Illegal interrupt of extended verb
Reselect extended verb after optics marking is completed.

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

**01302 SQRT called with negative argument
See 01204.

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

01426 IMU unsatisfactory
Realign or use SCS.

01427 IMU reversed
Note FDAI operation is inverted.

**01501 Keyboard and display alarm during internal use
See 01204.

CSM & SUBS Basic Date APR 15, 1969
Changed JUNE 27, 1969

**01502	Illegal flashing display See 01204.
01520	V37 request not permitted at this time Wait till COMP ACTY lt. not on continuously - reselect V37 or if P62-67, select P00 and then desired program.
**01521	V92 keyed (P07) during P00 or P01 selected and P11 has already been performed See 01204.
01600	Overflow in drift test This is gnd test alarm only.
01601	Bad IMU torque abort See 01600
01602	Bad optics during verification See 01600
01703	Insufficient time for integration, TIG slipped (F/5-4,5-10,E/4-4)
(m)03777	ISS warning caused by ICDU fail (G&N 6)
(m)04777	ISS warning caused by ICDU & PIPA fail (G&N 6)
(m)07777	ISS warning caused by IMU fail (G&N 6)
(m)10777	ISS warning caused by IMU & PIPA fail (G&N 6)
(m)13777	ISS warning caused by IMU & ICDU fail (G&N 6)
(m)14777	ISS warning caused by IMU,ICDU & PIPA fail (G&N 6)

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

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

CSM 107 & SUBS Basic Date APRIL 15, 1969
Changed JUNE 7, 1969

V50 N25 CHECKLIST CODES

R1 Code	ACTION	FUNCTION
00013	Key in	Gyro Torque Option (P52,54)
00014	Key in	Fine Align Option
00015	Perform	Celestial Body Acq
00016	Key in	Terminate Mark Sequence
00041	Switch	CM/SM SEP to UP
00062	Key	CMC to STBY
00202	Perform	PGNS AUTO MNVR
00204	Key in	Engine gimbal test opt

V04 N06 (N12)OPTION CODES

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

CSM 17 & SUBS
Basic Date APRIL 5, 1969
Changed JUNE 27, 1969

FLAG WORD LISTING

TITLE	ADDRESS	BIT	WHEN SET	WHEN RESET
RNDZ	00074	7	P20 initiated	P20 terminated
UPDATE	00075	7	State vector update by marks allowed	State vector updating by marks not allowed
Track	00075	5	RNDZ Tracking allowed	Rendezvous tracking not allowed
Pref Att	00076	4	Pref Att computed	Preferred S/C attitude not computed
Steer	00076	11	Steering to be done	Steering omitted
REFSMMAT	00077	13	REFSMMAT good	REFSMMAT not good
IMU	00074	8	IMU in use	IMU not in use
State Vector	00075	8	CSM State vector updated	LM state vector updated
Terminate	00103	15	Terminate R52,R53	Do not terminate
Trunnion drive	00074	4	Enables CMC contr of trunnion	CMC control of optics trunnion not enabled
Target 1	**00075**	**10**	**LM sighting**	**Not sighting LM**
Target 2	**00075**	**9**	**LMK Sighting**	**Sighting star**
W-matrix(RNDV)	**00101**	**1**	**W-matrix for rendezvous navigation is valid**	**W-matrix for rendezvous navigation is invalid**
W-Matrix (ORB)	**00077**	**6**	**P22,P23 W-matrix valid**	**P22,P23, W-matrix invalid**
3 axis	**00101**	**6**	**MNVR Specified by 3 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**
Sighting mark	**00074**	**6**	**V51 initiated**	**V51 not initiated**

F 1-15

F 1-16

Stick flag	00075	14	RHC out of detent	RHC in detent (auto maneuver enabled)
CMOON flag	00104	12	Permanent CSM SV in Lunar Sphere of Influence	Permanent CSM SV in Earth Sphere of Influence

NON-FLAGS

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

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

1 Set
0 Reset

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

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.

SM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

SECTION 2. G&N GENERAL

CMC POWER UP PROCEDURE (PWR UP OPTICS + IMU FIRST)

1 PRO, push until STBY Lt - out
(repeat, if necessary)
CMC warning, RESTART, PROG ALARM
*RSET and continue *

2 F 37 00E

IMU POWER UP PROCEDURE

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

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

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

P06 - CMC POWER DOWN PROGRAM

(BEFORE IMU & OPTICS PWR DN)

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

Basic Date April 15, 1969
Changed June 6, 1969
CSM 107 & SUBS

PRO, push until STBY lt - on

OPTICS DUST COVER JETT

Install Eyepieces
OPT ZERO - OFF
G/N PWR OPTICS - on (up)
OPT MODE - MAN
OPT COUPLING CONT - DIRECT
OPT SPEED CONT - HI
OHC - MAX RIGHT (Obs eject thru eyepiece)

OPTICS POWER UP PROCEDURE

1 G/N PWR OPTICS - on (up)

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

OPTICS POWER DOWN

1 G/N PWR OPTICS - OFF

IMU POWER DOWN PROCEDURE

CMC MODE - FREE

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

CMC SELF CHECK

1 V25 N01E, 1365E
F 21 01 E,E,E

2 V15 N01E, 1365E
15 01 R1 NUMBER OF ERRORS
R2 NUMBER OF TESTS STARTED
R3 NUMBER OF TESTS SUCCESSFUL

Basic Date April 15, 1969
Changed June 6, 1969

CSM 107

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

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

MEASUREMENT & LOADING OF PIPA BIAS

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

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

3 V06 N21 (DO NOT ENTR)
16 21 XYZ PIPA COUNTS

4 At T + 4:16 - ~~VERB~~ ENTR
T4:16
RECORD (X) R1 ____ (Y) R2 ____ (Z) R3 ____ ±(XXXAB)

5 V21N 01E USE SAME SIGN AS ABOVE
F 21 01 1452 E (CALCULATED X BIAS) E,E,(±ABXXX)
1454 E (CALCULATED Y BIAS) E,E
1456 E (CALCULATED Z BIAS) E

FLAG WORD SET/RESET

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

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

	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

Basic Date April 15, 1969
Changed May 20, 1969

3 F 23 07
(SET BIT) Key 1E
(RESET BIT) Key 0E

4 (To Verify) V01 N01E (FLAG Word ADD) ENTR

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

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

Key:

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

EXAMPLE: To set REFSMMAT flag:

Key:

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

Basic Date. April 15, 1969
Changed May 20, 1969

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

REVIEW DATA IN ERASABLE MEMORY

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

TO CHANGE DATA IN ERASABLE MEMORY

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

P22 RAW DATA READOUT

CMC - on, HOLDING AT 06 49 FLASH IN P22

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

MONITOR OF INPUT/OUTPUT CHANNELS

30 E IMU/CDU
31 E RNC
32 E MIC
33 E VHF RANGE Good
XXXXS

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

LOAD OUTPUT CHANNELS

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

PITCH ORBIT RATE MANEUVER
(Save RCS - Disable 2 Adjacent Quads in RO3)

1		V37E 00E
		V49E
		Load V06N22 With Desired Initial Attitude MGA=0
2	F 06 22	
		PRO
3	F 50 18	BMAG MODE (3) - RATE 2
		SC CONT - CMC
		CMC MODE - AUTO
		PRO
4	06 18	AUTO MANEUVER
	F 50 18	
5		ENTR
6		V24 N01E
		3127E
		VVVVV E
		WWWWW E

Basic Date April 15, 1969
Changed June 6, 1969
M 107 & SUBS

7 V24E
3131E
XXXXX E
YYYYY E

8 V21E
3200 E
ZZZZZ E
ORB RATE MAN Now In Progress

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

TABLE 1

CDUX

ORB RATE	0 deg	+90 deg	+180 deg	+270 deg
	VVVVV=77776	00000	00001	00000
	WWWWW=46200	70400	31600	07400
-0.050	XXXXX=00000	00001	00000	77776
	YYYYY=70400	31600	07400	46200
	ZZZZZ=61337	61337	61337	61337

RCS DAP ATT DBD INCREASE

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

1 V21 N01E
3255E
DBD (see table)

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

2 To return to RO3 DBD
THC - CW, then neutral
(DBD center shifted)
or V48E (DBD center not affected)
PRO
PRO
PRO
or V37E XXE

G&N RECOVERY PROCEDURES

General System Checkout:

Get to POO by one of the following:
1. V37E 00E
2. V96E
3. V36E V96E
4. Simultaneously press RSET and MARK REJECT, (GO JAM), V37E 00E

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

Recoveries:

if P06: (with F 50 25 00062)
1. a. Press PRO to STBY, press PRO again to F 37

Basic Date April 15, 1969
Changed JUNE 27, 1969
CSM & SUBS

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

if V30 or 31:
RECORD N26, NOTIFY MSFN, V74E
Perform General System Checkout

if V36:
1. V25 N7E, 76E, 40000E, 1E
2. V48
3. V46
4. Perform General System Checkout as necessary

if GO JAM:
V74 when convenient, see V36

RAPID IMU REALIGN

NOTE: This procedure assumes a good GDC alignment

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

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

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

(continued on next page)

Basic Date April 15, 1969
Changed June 27, 1969

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

5 V25 NO7E
77E, 10000E, 1E (Sets REFSMMAT FLAG)

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

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

VHF RNG DSKY DISPLAY
VHF RNG - on
P20 - running

1 V87E

V06 NO2E
3703E
R1 = XXX.XX nm
(max R1 = 163.83;
If R1 neg, RNG = 327.67-R1)

Basic Date- April 15, 1969
Changed June 27, 1969

CHANGING LANDING SITE REFSMMAT FOR OUT OF PLANE BURNS

1	V37E 52E		
2	F 04 06		R1=00001 R2=00004 (LOAD LANDING SITE OPTION)
3	F 06 34		GET ALIGN (LOAD TIME OVER LANDING SITE)
4	F 06 89		LAT, LONG/2,ALT (LOAD R1: +035000 FOR +ΔVy or -035000 FOR -ΔVy)
5	F 06 22		NEW ICDU ANGLES
6	F 50 25		R=00013 CMC MODE=FREE ENTER TO GYRO TORQUE
7		16 20	UNTIL TORQUING COMPLETE
8	F 50 25		R1=00014 ALIGNMENT CHECK ENTR
9	P30		
10	P40		
11	YAW BACK TO ∿0° (MANUALLY)		
12	V37E 52E		R1=00001 R2=00004
13	F 04 06		(LOAD LANDING SITE OPTION)
14	F 06 34		GET ALIGN (LOAD PREVIOUS TIME)
15	F 06 89		LAT, LONG/2,ALT (LAT WILL BE CHANGED BACK TO CORRECT VALUES)
16	F 06 22		NEW ICDU ANGLES
17	F 50 25		R=00013 CMC MODE=FREE ENTR TO START TORQUING
18		16 20	UNTIL TORQUING COMPLETE
19	F 50 25		R1=00014 ALIGNMENT CHECK PRO (TO SELECT 2 STARS IF TIME PERMITS) ENTR (TO LEAVE P52)

Basic Date — April 15, 1969
Changed — June 27, 1969

CSM 107 / LUBS

P17

SECTION 3. - NAVIGATION

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

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

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

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

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

5 F 37 XXE

P20 - RENDEZVOUS NAVIGATION
CMC - on (req)
ISS - on and aligned (req)
SCS - on (des)

Basic Date APRIL 15, 1969
Changed MAY 14, 1969

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

1               V37E 20E
F 50 18         Request MNVR to FDAI RPY angles  (.01°)

     (AUTO)     SC CONT - CMC
                CMC MODE - AUTO
           PRO
     06 18      RPY (.01) to 1 when MNVR complete
     (MAN)      SC CONT - SCS
           PRO To 1
       or V62E
           RHC - MNVR To 1

     When attitude OK:
                CMC MODE - AUTO
           ENTR
                OPTIC ZERO - OFF
                *POSS prog alarm                 *
                *Key V5N9E 00407 (TA>50°)        *
                *V16N 22E                        *
                *GMBL ANGLES RPY       (.01°)    *
                *or V16N 92E                     *
                *OPTICS SHAFT,TRUN(.01°,.001°)*
                *(AUTO) SC CONT - CMC            *
                *       CMC MODE - AUTO          *
                *       V58E                     *
                *(MAN) MNVR to 2 (SXT)            *
                *       or to 3 (COAS)           *

2               V57E (SXT)
F 51            OPT MODE - MAN
                OHC - Cntr Target in SXT
           MARK (repeat as necessary)

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


Basic Date APRIL 15, 1969
Changed MAY 14, 1969

P21

OPT ZERO - ZERO

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

3 V54E (COAS)
F 06 94 SHAFT, TRUNNION (.01°,.001°)
PRO

4 F 53 Request Alt LOS MARK
RHC - ALIGN Target in COAS
ENTR (V86E To reject)
POSS F 06 49 ΔR,ΔV,source code
* (.1nm,.1fps,0000X) *
*(REJECT) V32E *
*(ACCEPT) PRO *

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

Basic Date April 15, 1969
Changed June 6, 1969

P21 GROUND TRACK DETERMINATION

CMC - on (req)

1 V37E 21E
F 04 06 R1 00002, Specify Vehicle
R2 00001, CSM
or 00002, LM
PRO

+ = EAST
- = WEST

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

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

P22 - ORBITAL NAVIGATION

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

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

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

Basic Date April 15, 1969
Changed June 6, 1969

CSM 107 & SUBS

P 2 2

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

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

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

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

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

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

Basic Date April 15, 1969
Changed June 6, 1969

CSM 107 & SUBS

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

10 F 37 XXE
OPT ZERO - ZERO

P23

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

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

2 F 50 25 00202 MNVR/CALIB REQUEST
ENTR

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

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

NOTE: IF HAVING DIFFICULTY WITH OPTICS CALIB, LOAD ZEROES (V22N87E, +00000E) AND REPEAT CALIB AFTER MARK PERIOD.

5 F 51 V37E XXE
OPT ZERO - ZERO

Basic Date— April 15, 1969
Changed— June 6, 1969

CR 107 & SUBS

P23

F
3-7

P23 - CISLUNAR MIDCOURSE NAV MEASUREMENT

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

DO NOT ALLOW P23 TO RUN MORE THAN 30 MIN

1		V37E 23E
2	F 05 70	R1 000DE STAR ID R2 00C00 LMK ID R3 00CD0 HOR ID

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

STAR/EFH	STAR/LFH	STAR/LL
000DE	000DE	000DE
00000	00000	00200
00120	00220	00000

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

3	F 06 89	LAT, LONG/2, ALT (LMK) (.001°N/E, .01nm) PRO (DE≠00 to 5)
4	F 06 88	CELESTIAL BODY VECTOR LOAD DESIRED VECTOR PRO
5	F 50 25	00202 MNVR/CALIB REQUEST (MNVR) PRO (CALIB) ENTR to 8

Basic Date — April 15, 1969
Changed — JUNE 27, 1969

CSM 107 & SUBS

6	F 50 18	REQUEST MNVR TO FDAI R,P,Y (.01°) (AUTO) SC CONT - CMC CMC MODE - AUTO BMAG MODE (3) -RATE 2 PRO to 7 (MAN) V62E MNVR to 6 (BYPASS) ENTR to 8 (CALIB COMPLETED to 10)
7	06 18	AUTO MNVR FDAI R, P, Y (.01°) AUTO MNVR COMPLETE RETURN TO 6
8	F 59	REQUEST OPTICS CALIB (BYPASS) ENTR to 10 OPT MODE - MAN OPT COUPLING - DIR SPEED - LOW OPT ZERO - OFF SUPERIMPOSE LLOS ON SLOS MARK
9	F 06 87	R2 TRUN BIAS (.001°) For manual load: V22 N94E XXXXXE (RECALIB) V32E to 8 (INCORP CALIB) OPT MODE-CMC PRO
10	06 92	AUTO OPT SHF/TRUN (.01°,.001°) (MNVR) V94E to 6 *PROG ALARM * *V5N9E 407 TRUN > 50° * *KEY RLSE * *MNVR SC UNTIL R2 <49.775°* (MARK) MNVR SC TO POSITION LMK/HOR IN FOV OPT MODE - MAN

Basic Date April 15, 1969
Changed JUNE 27, 1969

C 107 & SUBS

11	F 51		MARK REQUEST (MNVR) V94E to 6 (MARK) SUPERIMPOSE STAR ON LMK/HOR MARK
12	F 50 25		00016 TERM MARKS (REJECT) MARK REJECT to 11 (TERM) PRO
13	F 05 71		R1 000DE STAR ID R2 00C00 LMK ID R3 00CDO HOR ID (STAR/HOR) PRO to 16 (DE=00 to 15) (STAR/LMK) PRO to 14
14	F 06 89		LAT, LONG/2 ALT(LMK) (.001°+N/E,.01nm) PRO (DE≠00 to 16)
15	F 06 88		CELESTIAL BODY VECTOR Verify vector PRO
16	F 06 49		ΔR ΔV (SV PARA) (.1nm,.1 fps) (REJECT) V37E 23E (UPDATE) PRO
17	F 37		

Basic Date — April 15, 1969
Changed — NE 27, 1969

CSM 107 & SUBS

P27 CMC UPDATE

CMC - on (req)

Auto Update:

1 V37E 00E

UP TLM (2) - ACCEPT

UPLINK ACTY lt - on

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

```
                        *  Key V34E                  *
                        *  UPLINK ACTY lt - out      *
                        *  P00 displayed             *
                        *UP TLM (2) - BLOCK          *
```

Update complete:
UPLINK ACTY lt - out
V37E 00E
UP TLM (2) - BLOCK

Voice Transmission Update:

1 V37E 00E

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

3 P27 Displayed

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

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

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

7 P00 Displayed

Basic Date April 15, 1969
Changed June 27, 1969
C 107 & SUBS

P30

SECTION 4. PRETHRUST

P30 EXTERNAL ΔV

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

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

P31 GENERAL LAMBERT PRETHRUST

TARG PARAMS - LOADED FROM GND (P27)

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

Basic Date APRIL 15, 1969
Changed JUNE 27. 1969
CSM 107 & SUBS

4	F 16 45	M,TFI,MGA	(MKS,min-sec,.01°)
		Set DET	
		PRO (MGA Set to -00002 IF REFSMMAT FLAG NOT SET)	
5	F 37		

P32 CSI PRETHRUST

1		V37E 32E	
	F 06 11	TIG (CSI)	(hrs,min,.01sec)
		PRO	
2	F 06 55	APSIS CDH,TPI ELEVATION ANGLE,(+0000N,.01°) CENTRAL ANGLE,Passive Vehicle (ω t) (For CDH Nπ from CSI, load non-zero in R3)	
		PRO	
3	F 06 37	TIG (TPI)	(hrs,min,.01sec)
		PRO	
4	F 16 45	MARKS,TFI,-00001	(marks,min-sec)
		(RECYCLE) V32E to 5	
		(FINAL PASS) TERM MARKS	
		PRO	

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

Basic Date APRIL 15, 1969
Changed JUNE 27. 1969

CSM 107 & SUBS

4. PRETHRUST (P30's)

P33

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

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

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

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

9 F 37

Basic Date APRIL 15, 1969
Changed JUNE 27, 1969

P33 CDH PRETHRUST

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

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

*F 05 09 00611 NO TIG FOR *
* SPECIFIED ANGLE *
* (REDO)V32E to 1 *
* PRO to 3 *
*CMC WILLuse last cal- *
* culated value of ~~PRC~~ TPI *

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

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

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

6 F 37

P34 TPI PRETHRUST (P74 LM)

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

2 F 06 55 Precision offsets, ELEV ANGLE, ωt
(XXXXX,.01°,.01°)

Basic Date APRIL 15, 1969
Changed JUNE 27, 1969

CSM 7 & SUBS

P34

Load desired values
(+00000 in R2 to CALC ELEV
ANGLE AT TIG TIME)
PRO

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

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

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

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

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

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

Basic Date April 15, 1969
Changed June 6, 1969
CSM 107 & SUBS

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

9 F 37
P74 - Transmit Mnvr Parameters To LM

P35 TPM PRETHRUST (P75 LM)

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

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

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

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

5 F 37
P75 - Transmit Mnvr Parameters To LM

Basic Date April 15, 1969
Changed June 6, 1969
I 107 & SUBS

P37

P37 RETURN TO EARTH PGM - CORRIDOR CONTROL

MAKE SURE DAP HAS CORRECT WEIGHT

Perform the following once:
If TLI+10 min Abort performed
V21 N1E
3376E
0E
If no TLI+10 min Abort
V1N1E
3376E
Verify R1=01637

1 V37E 37E
F 06 33 TIG (hrs,min,.01sec)
Load desired TIG (outside lunar sphere)
PRO
→ check Pad

2 F 06 60 BLANK,V DESIRED,GAMMA EI (fps,.01°)
Load desired values
FOR MIN ΔV-LOAD +00000 IN R2
(Use PAD values on TLC)
For middle of corridor-load +00000 in R3
PRO (γ = -6.48°)

```
*F 05 09 00605-Solution Not   *
*              Convergent     *
*        00612-State Vector in*
*              Lunar Influence*
*V32E,RSET To 1               *
*        00607-Conic Routine   *
*              Failed         *
*        00610-State Vector    *
*              Below 400K ft  *
*              alt            *
*F 37 37E to 1                *
```

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

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

Basic Date April 15, 1969
Changed June 1969

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

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

```
*F 05 09 00605 Solution Not   *
*              Convergent     *
*        00613 Flt Path Angle *
*              Not Reached    *
*  RSET                       *
*  V32E To 1                  *
*        00607 Conic Routine  *
*              Failed         *
*F 37 37E to 1                *
```

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

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

9 F 16 45 MARK,TFI,MGA (mark,min-sec,.01°)
PRO (MGA SET TO -00002 If No
REFSMMAT SET)

10 F 37 (40E or 41E)

Basic Date April 15, 1969
Changed June 7, 1969

P37

F
4-9

P37 RETURN TO EARTH PGM - LONGITUDE CONTROL
(CANNOT USE WHEN TIME TO ENTRY IS <4 HRS)

RADIUS VECTOR

Perform the following once:
  If TLI+10 min Abort performed
    V21 N1E
      3376E
        0E
If no TLI+10 min Abort
    V1N1E
    3376E
    Verify R1=01637

1 V37E 37E

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

2 F 06 60 BLANK, ΔV DESIRED, GAMMA EI DESIRED
Load desired ΔV: (fps,.01°)
PAD ΔV IF ON TLC
0. IF ON TEC
Load R3=0
R2 XXXXX
PRO

*F 05 09 00612 State vector in *
* Lunar Influence *
* 00605 Solution not *
* Convergent *
*V32E, RSET TO 1 *
* 00607 Conic Routine *
* Failed *
* 00610 State vector is *
* below 400K ft *
* altitude *
*F 37 37E to 1 *

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

Basic Date April 15, 1969
Changed June 2 1969

If Impact LONG>12° from desired:

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

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

4 F 06 39 ΔT TRANSFER from specified (hrs,min,.01sec)
PRO Tig time (N33) to 400K

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

6 F 06 81 ΔVXYZ(LV) at TIG
N40E (RMS OF N81)
Record R2 as ΔVc1=_____fps
KEY RLSE
PRO for Precision Solution

```
*F 05 09  00605 Solution not  *
*                Convergent   *
*         00613 Flt Path Ang  *
*                not reached  *
*RSET V32E to 1               *
*         00607 Conic Routine *
*                Failed       *
*F 37 37E to 1                *
```

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

PRO

8 F 06 39 ΔT TRANSFER
PRO

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

10 F 06 81 ΔVXYZ(LV) at TIG
N40E

Basic Date April 1969
Changed June 27, 1969

P37

F
4-11/12

R2 XXXX.X Record as ΔVp1 =_____.____fps
V32E to 11

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

12 F 06 60 BLANK,ΔV DESIRED, GAMMA EI DESIRED
To move West from θp1 NOTE
TEC:R2Load ΔVc2 =-ΔVc1-10
TLC: Load ΔVc2 =ΔVc1-10
To move EAST from θp1
TLC or TEC: Load ΔVc2=ΔVc1+10
Record ΔVc2_____fps
R2 XXXXX.
PRO
F 05 09 SAME AS IN 2
*V32E. RSET to 11 *

Basic Date April 15, 1969
Changed June 27, 1969

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

PAY CLOSE ATTENTION TO SIGNS

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

Compute ΔθLong =θd-θp1= ± _____

Obtain from Chart ΔVo = ± _____

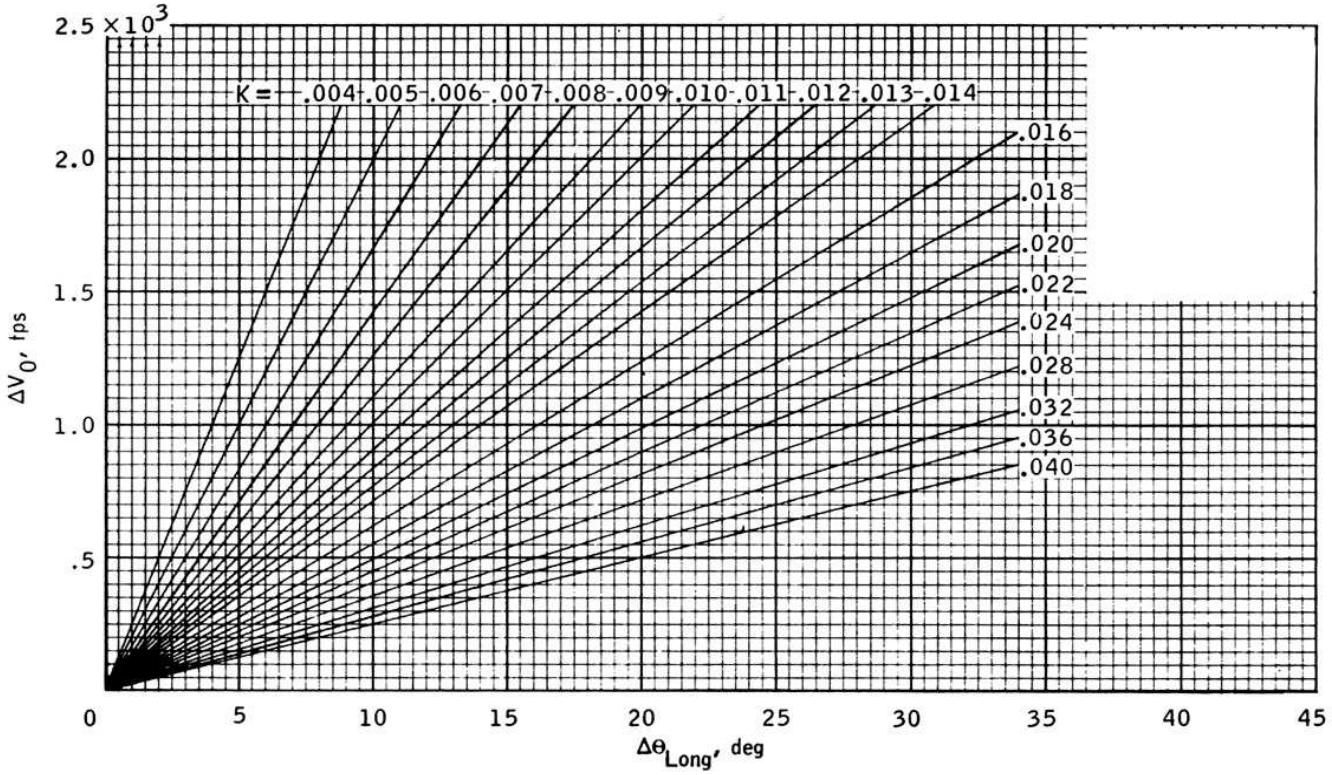
Make sign of ΔVo same as Δθ Long
If ΔVc2 pos, ΔVd= ΔVp1(step 10)+ ΔVo
If ΔVc2 neg, ΔVd= -ΔVp1+ ΔVo
ΔVd=_____

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

OBTAIN ENTRY REFSMMAT (No Comm)

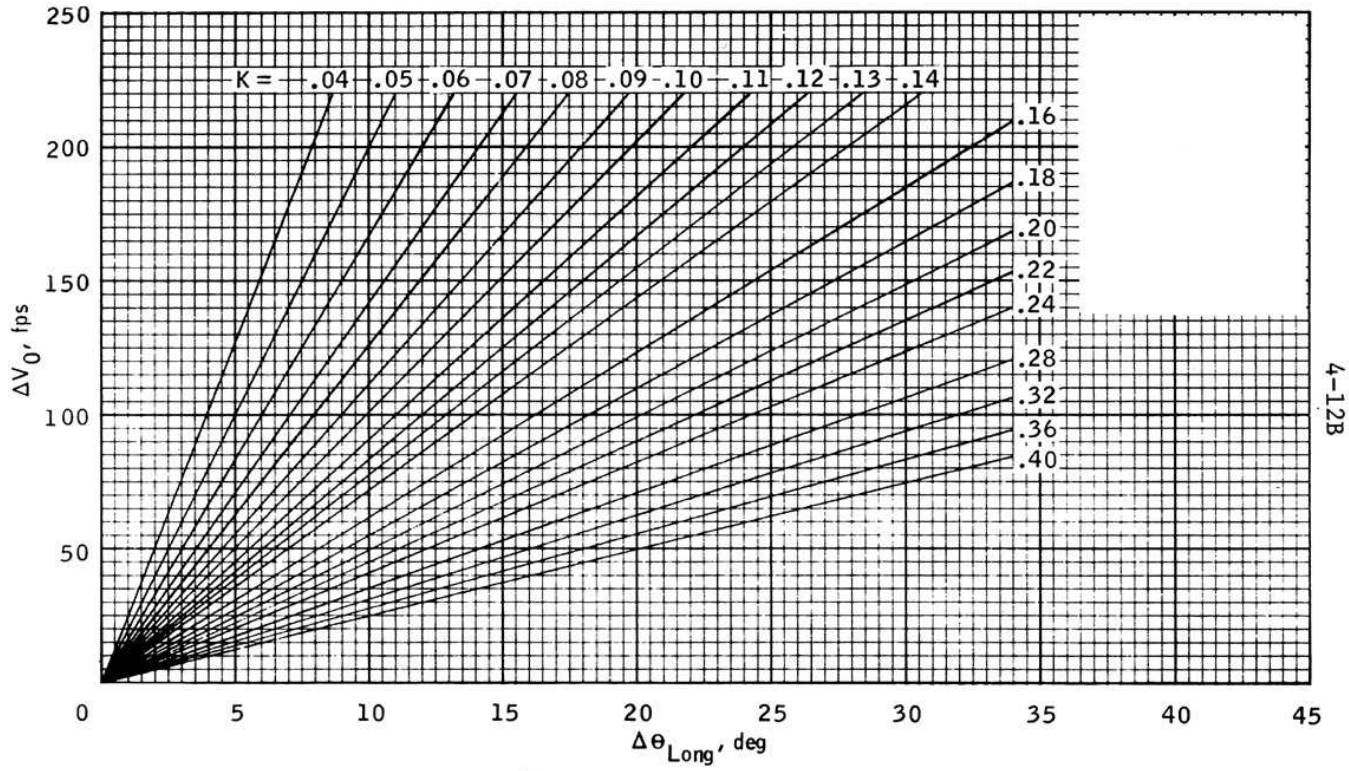
1. Record 400K time from final P37 solution. (Step 1 TIG + FNL N39)
2. Use 400K time for T-align P52 (Option 2).
NOTE: P37 MCC used to compute T-align must be performed prior to step 2.

Basic Date JUNE 13, 1969
Changed July 5, 1969 REV I



F 4-12A

ΔV_0 versus Δ Long, K = .04 to .004.



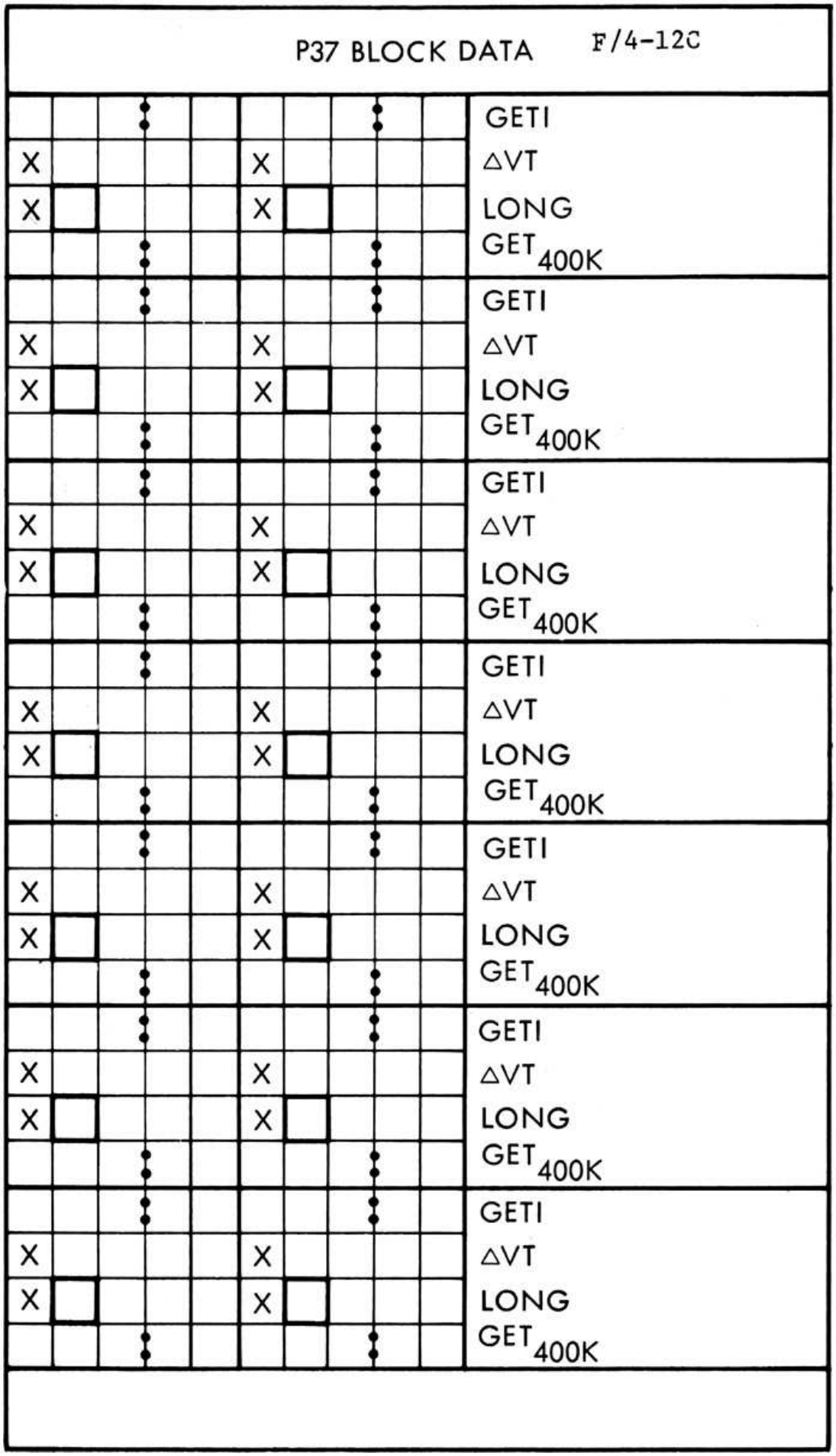
F 4-12B

ΔV_0 versus Δ Long, K = .4 to .04.

Basic Date JUNE 13, 1969
Changed July 5, 1969 REV I

Basic Date APRIL 1, 1969
Changed — MAY 27, 1969

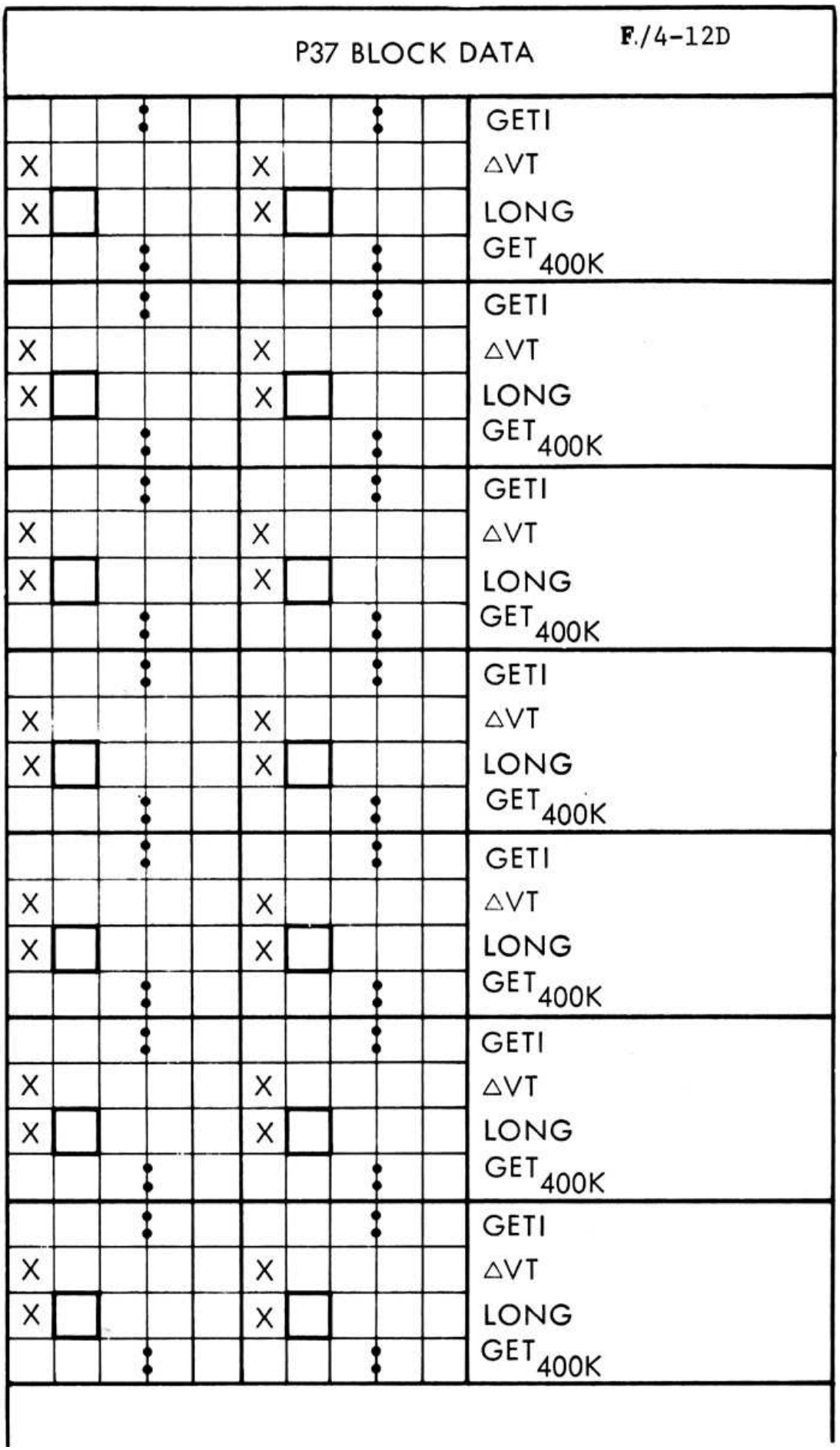
P37 BLOCK DATA F/4-12C



P37 BLOCK DAT

P37 BLOCK DATA

F./4-12D



Basic Date Apr 1, 1969
Changed June 27, 1969

P38

F
4-13

P38 SOR TARGETING (P78 LM)

V37E (38E or 78E)

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

2 F 06 55 R3 ωt (.01°)
Load desired ωt
PRO

3 F 04 06 R1 00005 Specify Phase Option
R2 0000X X=1 or 2
PRO (To 6 If R2=2)

4 F 06 57 ΔR SOR (.1nm)
Load desired ΔR
PRO

5 F 06 34 SOR TIME (hrs,min,.01sec)
PRO

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

7 F 06 58 HP(SOR),ΔV(SOR),ΔV(SOR-FINAL)
PRO (.1nm,.1fps,.1fps)

8 F 06 81 ΔVXYZ(LV) (.1fps)
PRO (If Recycle - To 6)

9 F 16 45 MARKS,TFI,MGA (marks,min-sec,.01°)
PRO (MGA SET TO -00002 IF NO
REFSMMAT SET OR P78)

10 F 37

P78 - Transmit Mnvr Parameters To LM

Basic Date April 15, 1969
Changed June 2, 1969

P39 STABLE ORBIT MID (P79 LM)

1			V37E (39E or 79E)
2	F	16 45	MARK,TFI,-00001 (mark,min-sec,.01°) (RECYCLE) V32E (FINAL PASS) PRO (Terminate Marks)
3	F	06 81	ΔVXYZ(LV) (.1fps) PRO (If Recycle - To 2)
4	F	16 45	MARK,TFI,MGA (mark,min-sec,.01°) PRO (MGA SET TO -00002 IF NO REFSMMAT SET or P79)
5	F	37	

P79 - Transmit Mnvr Parameters To LM

Basic Date April , 1969
Changed June 27, 1969

P40

SECTION 5. THRUSTING

Basic Date April 15, 1969
Changed JUNE 27. 1969

CSM 107 & Subs

P40-SPS THRUSTING

CHECK FOR WATER IN TUNNEL AREA

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

MNVR TO PAD BURN ATT

1 V62E

2 V49E

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

THRUSTING (P40's)

4	F 50 18	REQ MNVR TO FDAI RPY ANGLES		(.01°)
		(AUTO) PRO		
		(MAN) SC CONT - SCS		
		MNVR To 6		
5	06 18	AUTO MNVR TO FDAI RPY ANGLES		(.01°)
6	F 50 18	REQ TRIM TO FDAI RPY ANGLES		(.01°)
		(AUTO TRIM) PRO To 5		
		(BYPASS) ENTR		
7		BORESIGHT & SXT STAR CHECK		
		OPT MODE - CMC		
		OPT ZERO - OFF		
8		V41 N91E		
9	F 21 92	SHAFT, TRUN		(.01°,.001°)
		LOAD SXTS angles		
10	41	OPTICS DRIVE		
		CHECK SXT STAR		
		OPT ZERO - ZERO		
		CHECK BORESIGHT STAR (If avail)		
11		V37E 40E		
12	F 50 18	REQUEST MNVR TO FDAI RPY ANGLES		(.01°)
		(AUTO) BMAG MODE (3) - RATE 2		
		SC CONT - CMC/AUTO		
		PRO To 13		
		(MAN/DAP) BMAG MODE (3) - RATE 2		
		SC CONT - CMC/HOLD		
		MNVR To 14		
		(MAN/SCS) SC CONT - SCS		
		MNVR To 14		
13	06 18	AUTO MNVR TO FDAI RPY ANGLES		(.01°)

Basic Date April 15, 1969
Changed JUNE 27, 1969

CSM 107 Subs

P40

14 F 50 18 REQUEST TRIM MNVR TO FDAI RPY ANGLES

ALIGN S/C ROLL (.01°)
GDC ALIGN

TVC CHECK & PREP
cb STAB CONT SYS (Pnl 8) - close
cb SPS (12) - close
ATT DB - MIN
RATE - LOW
LIMIT CYCLE - ON
MAN ATT (3) - RATE CMD
BMAG MODE (3) - RATE 2
ROT CONTR PWR DIRECT (2) - OFF
SCS TVC (2) - RATE CMD

* If SCS, SCS TVC (2) - AUTO *
* SC CONT - SCS *

TVC GMBL DRIVE P&Y - AUTO
+54:00m MN BUS TIE (2) - ON
(-06:00) 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

55:00m PRIMARY TVC CHECK
(-05:00) GMBL MOT P1-Y1 - START/ON (LMP Confirm)

If SCS, verify Thumbwheel Trim

THC - CW
Verify NO MTVC

SEC TVC CHECK
GMBL MOT P2-Y2 - START/ON (LMP Confirm)

SET GPI TRIM
Verify MTVC
THC NEUTRAL

Basic Date April 15, 1969
Changed Ju 16, 1969

CSM 107 & Subs

Verify GPI returns to 0,0(CMC) or trim(SCS)
ROT CONT PWR NORM #2 - AC/DC
SC CONT - CMC (verify)
(TRIM) GO to step 12
(BYPASS) BMAG MODE (3) - ATT1/RATE2
ENTR

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

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

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

(REJECT) ENTR

16 06 40 TFI,VG,ΔVM (min-sec,.1fps)

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

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

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

59:25
(-00:35) DSKY BLANKS

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

Basic Date April 15, 1969
Changed June 16, 1969

CSM 10 Subs

P40

F
5-5

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

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

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

MONITOR ΔVM (R3) COUNTING UP

59:55
(-00:05)
F 99 40 ENG ON ENABLE REQUEST
(AUTO IGN) PRO AT TFI ≥0 Sec
(BYPASS IGN) ENTR To 19
EXIT - V37E 00E
*ullage or DIRECT ullage *
17 00:00 IGN *IF SCS - THRUST PB - PUSH*

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

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

SPS THRUST Lt - 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

Basic Date April 15, 1969
Changed E 27, 1969

CSM 107 & Subs

*PROG ALARM *
V5 N9E 01407 VG INC
LOI & TEI THC - CW,
* FLY MTVC *
*LOI2 & MCC *
ΔV THRUST A&B - OFF

00:XX ECO

*EMER SPS CUTOFF: *
*ΔV THRUST A&B-OFF *
*LOI -BT+6 sec *
*LOI2 -BT +___ sec *
*TEI -BT+2 sec & *
* ΔV CTR<-40 fps *

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

19 F 16 85 VG XYZ(CM) (.1fps)
NULL RESIDUALS (TEI & MCC)
RECORD ΔV COUNTER & RESIDUALS ΔVC_____
EMS FUNC - OFF VGX_____
EMS MODE - STBY VGY_____
BMAG MODE (3) - RATE 2
ATT DB - MAX

PCM BIT RATE - LOW
TRANS CONT PWR - OFF
ROT CONTR PWR DIRECT (2) - OFF
cb SPS P1&P2,Y1&Y2 - open
PRO

20 F 37 V82E

CSM 10 Subs Basic Date A 1 15, 1969 Changed JUNE 27, 1969

P41

F
5-7

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

R3-59B59HP >49.4 nm/35K ft

PRO

22 F 37 00E

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

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

P41 - RCS THRUSTING

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

CSM 107 & Subs Basic Date April 15, 1969 Changed J 16, 1969

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

1 MNVR TO PAD BURN ATTITUDE
V62E

2 V49E

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

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

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

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

Basic Date A 1 15, 1969
Changed June 16, 1969
CSM 10) Subs

P41

7			BORESIGHT & SXT STAR CHECK OPT MODE - CMC OPT ZERO - OFF	
8			V41 N91E	
9	F	21 92	SHAFT, TRUN LOAD SXTS angles	(.01°,.001°)
10		41	OPTICS DRIVE CHECK SXT STAR OPT ZERO - ZERO CHECK BORESIGHT STAR (If avail)	
11			V37E 41E	
12	F	50 18	REQUEST MNVR TO FDAI RPY ANGLES (AUTO) BMAG MODE (3) - RATE 2 SC CONT - CMC/AUTO PRO To 13 (MAN/DAP) BMAG MODE (3) - RATE 2 SC CONT - CMC/HOLD MNVR To 14 (MAN/SCS) SC CONT - SCS MNVR To 14	(.01°)
13		06 18	AUTO MNVR TO FDAI RPY ANGLES	(.01°)
14	F	50 18	REQUEST MNVR TO FDAI RPY ANGLES (AUTO TRIM) BMAG MODE (3) - RATE 2 ALIGN SC ROLL SC CONT - CMC/AUTO PRO To 13 (BYPASS) ATT DB - MIN RATE - LOW MAN ATT (3) - RATE CMD BMAG MODE (3) - ATT1/RATE 2 GDC ALIGN ENTR	(.01°)
15		06 85	VG X,Y,Z	(.1fps)

CSM 107 & Subs Basic Date April 15, 1969
Changed June 1969

```
                    * 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

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

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

18    F 37          V82E

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

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

                    PRO

20    F 37          00E
```

Basic Date Apr 15, 1969
Changed Jun 16, 1969

CSM 107 ' Subs

P47

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

P47 Thrust Monitor Program

CMC - on
ISS - on & aligned

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

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

(RECYCLE) V32E
(TERM) PRO

2 F 37 XXE

Basic Date April 15, 1969
Changed June 16, 1969

CSM 107 & Subs

P51

SECTION 6. ALIGNMENTS

P51 - IMU ORIENTATION

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

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

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

3 F 51 PLEASE MARK
OPT ZERO - OFF
MARK

4 F 50 25 00016 TERMINATE MARKS
PRO

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

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

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

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

Basic Date April 15, 1969
Changed June 6, 1969
CSM 107 & SUBS

P52 IMU REALIGN

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

1			V37E 52E
	F	04 06	R1 00001 IMU ALIGN OPTION
			R2 00001 PREF PRO to 4
			2 NOM PRO to 2
			3 REFSMMAT PRO to 7
			4 LDG SITE PRO to 2
2	F	06 34	GET ALIGN (0,0, 0 initially) (hr,min,sec)
			Load desired GET
			TO SPECIFY PRESENT TIME - PRO on (0,0,0)
			PRO (NOM go to 4)
3	F	06 89	LAT, LONG/2, ALT (.001°,.001°,.01nm)
			Load ldg site coords
			PRO
4	F	06 22	NEW ICDU ANGLES OG, IG, MG (.01°)
			(IF MG>+70°, MNVR) V32E - to 4
			PRO
5	F	50 25	00013 GYRO TORQUE
			(COARSE) PRO - NO ATT lt - on then off - to 7
			(TORQUE) CMC MODE - FREE
			ENTR
6		16 20	ICDU ANGLES (.01°)
			When torque complete - go to 17
7	F	50 25	00015 STAR SELECT
			(MNVR If Necessary)
			(PICAPAR) PRO

Basic Date ril 15, 1969
Changed e 6, 1969
CSM 107 & SUBS

P52

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

(MAN ACQ) ENTR

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

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

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

(MARK ROUTINE) OPTICS MODE - MAN

11 F 51 PLEASE MARK
MARK

12 F 50 25 00016 TERMINATE MARKS
PRO

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

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

Basic Date APRIL 15, 1969
Changed MAY 14, 1969
CSM 107 & SUBS

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

(REJECT) V32E to 17
(ACCEPT) PRO

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

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

18 F 37
OPT ZERO - ZERO
XXE

P53 - BACKUP IMU ORIENT DETERMINATION

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

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

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

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

4 F 53 PLEASE MARK
Center Target
ENTR

CSM 7 & SUBS
Basic Date APRIL 15, 1969
Changed MAY 14, 1969

P53/54

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

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

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

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

9 F 37 XXE

P54 - BACKUP IMU REALIGN

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

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

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

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

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

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

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

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

(MAN ACQ) ENTR

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

9 F 06 88 CELESTIAL BODY VECTOR
Load desired vector
PRO

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

11 F 53 PLEASE MARK
Center Target
ENTR

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

Basic Date April 15, 1969
Changed June 6, 1969

C 07 & SUBS

P54

13 F 01 71 00000 STAR CODE
Load code (if necessary)
PRO to 8 after 1st MARK (to 14 if DE=00)
to 15 after 2nd MARK (to 14 if DE=00)

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

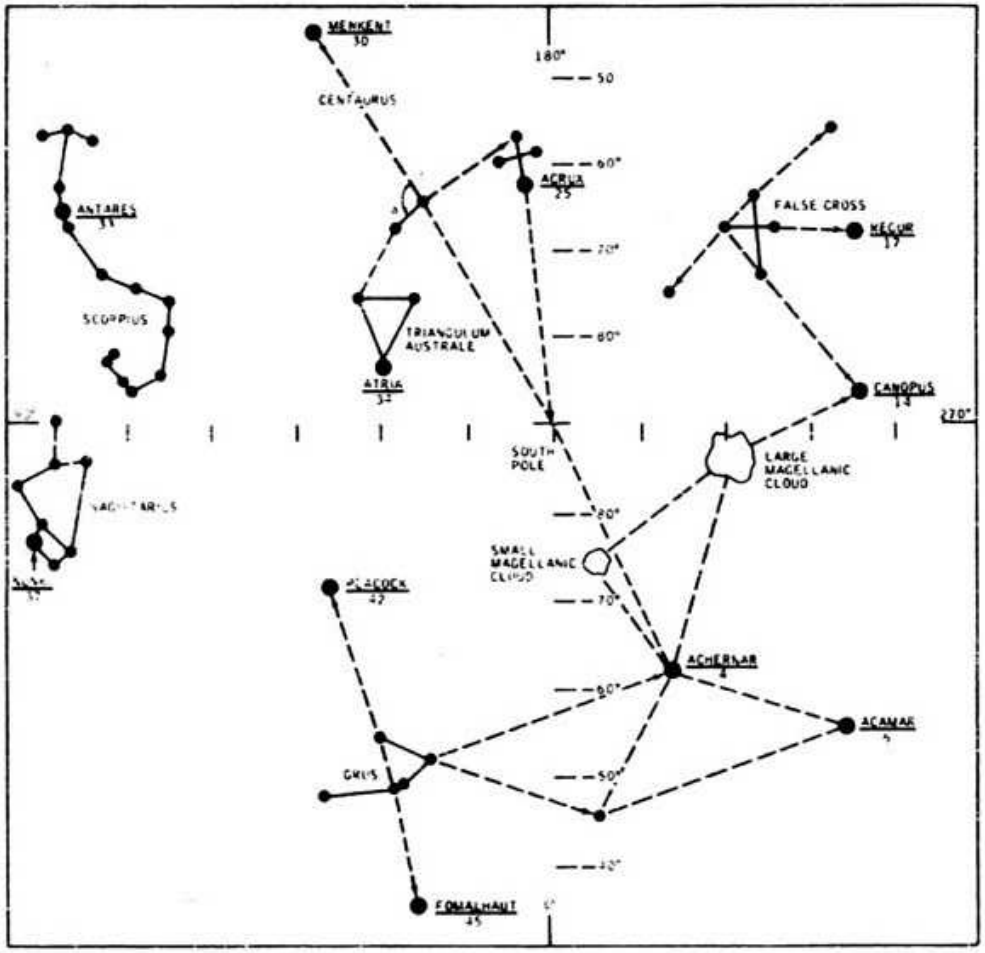
15 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(REJECT) V32E to 17
(ACCEPT) PRO

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

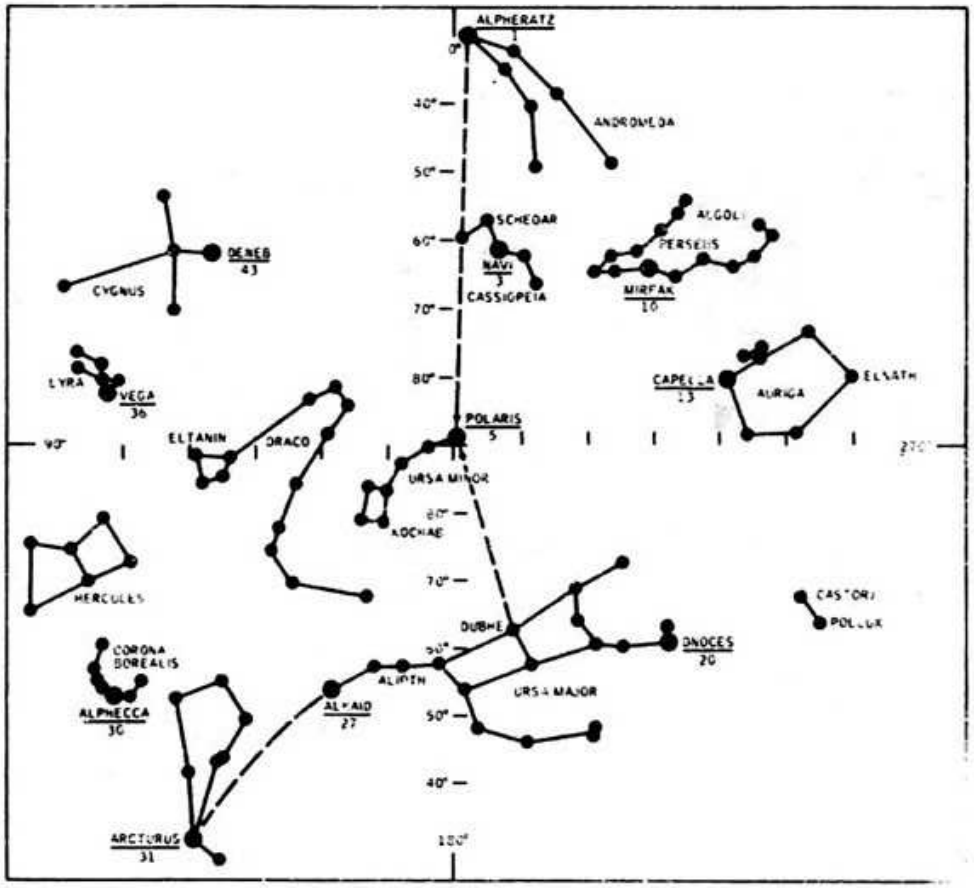
17 F 50 25 00014 ALIGNMENT CHECK
(RECHECK) PRO to 7
(BYPASS) ENTR

18 F 37 XXE

Basic Date - APRIL 15, 1969
Changed — MAY 14, 1969

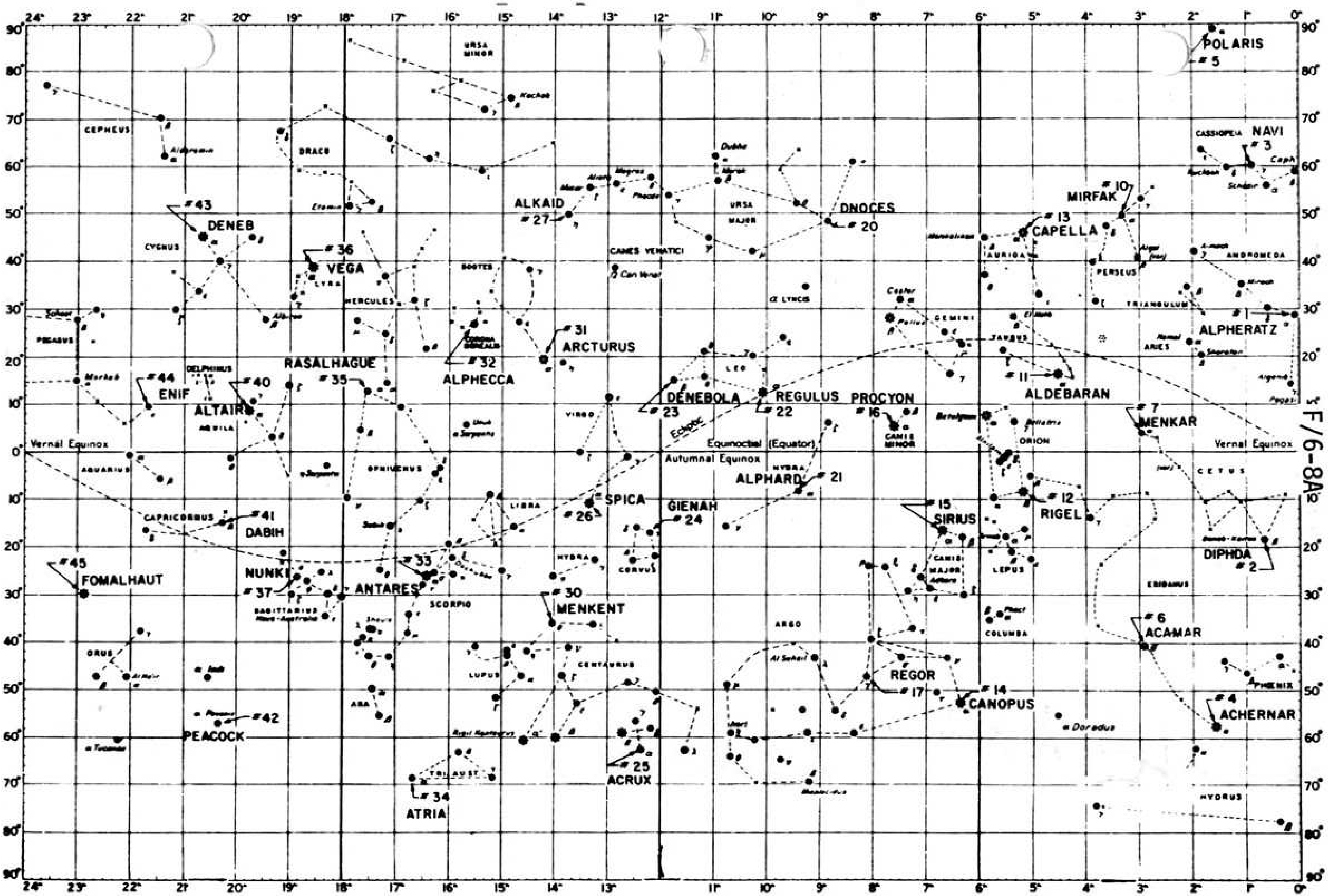


SOUTHERN STARS



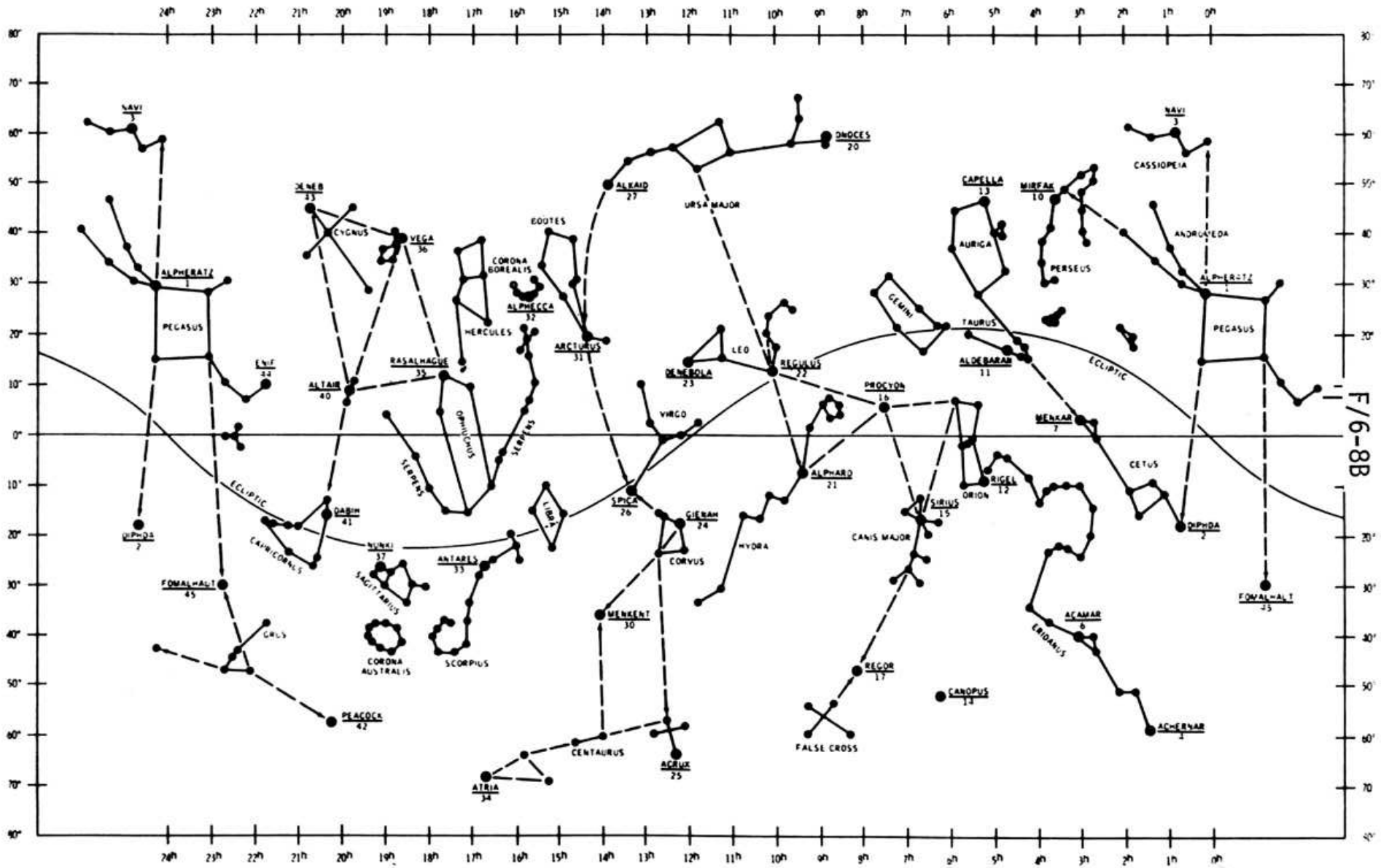
NORTHERN STARS

Basic Date April 1, 1969
Changed July 5, 1969 REV I


F/6-8A
POLARIS
NAVI
MIRFAK
CAPELLA
ALPHERATZ
ALDEBARAN
MENKAR
DIPHDA
ACAMAR
ACHERNAR
RIGEL
SIRIUS
CANOPUS
REGOR
PROCYON
REGULUS
ALPHARD
DENEBOLA
GIENAH
SPICA
ACRUX
ARCTURUS
ALKAID
DNOCES
ALPHECCA
MENKENT
ATRIA
ANTARES
RASALHAGUE
VEGA
NUNKI
DABIH
DENEB
ALTAIR
ENIF
PEACOCK
FOMALHAUT
Vernal Equinox
Autumnal Equinox
Equinoctial (Equator)
Ecliptic

Star Charts

Star Charts



F/6-8B

Basic Date . . il 1, 1969

Changed — July 5, 1969 REV I

Basic Date ____ 1969 REV I
Changed JULY

VENUS HALF-UNIT VECTORS

LIFTOFF - 16 JULY 69, 1330 HRS GMT

GET HRS	X vector	Y vector	Z vector
-1	.16785	.44066	.16630
9	.16410	.44183	.16693
19	.16034	.44297	.16756
29	.15657	.44409	.16817
39	.15280	.44517	.16877
49	.14901	.44623	.16937
59	.14521	.44726	.16995
69	.14141	.44826	.17052
79	.13759	.44923	.17108
89	.13377	.45017	.17164
99*	.12994	.45108	.17218
109*	.12611	.45197	.17271
119*	.12226	.45283	.17323
129*	.11841	.45365	.17374
139	.11455	.45445	.17424
149	.11068	.45522	.17474
159	.10680	.45596	.17522
169	.10292	.45667	.17569
179	.09903	.45735	.17615
189	.09513	.45801	.17660
199	.09122	.45863	.17704

* Venus is visible from the landing sites.

PLANET VECTORS
16 JULY 1969

MARS HALF-UNIT VECTORS

LIFTOFF - 16 JULY 69, 1330 HRS GMT

GET HRS	X vector	Y vector	Z vector
-1	-.23404	-.39277	-.20239
39	-.23249	-.39349	-.20278
79	-.23053	-.39441	-.20324
119	-.22818	-.39550	-.20377
159	-.22546	-.39676	-.20434
199	-.22244	-.39815	-.20495

JUPITER HALF-UNIT VECTORS

LIFTOFF - 16 JULY 69, 1330 HRS GMT

GET HRS	X vector	Y vector	Z vector
-1	-.49989	-.00530	.00943
79	-.49986	-.00910	.00768
159	-.49980	-.01306	.00587
239	-.49970	-.01714	.00401

SATURN HALF-UNIT VECTORS

LIFTOFF - 16 JULY 69, 1330 HRS GMT

GET HRS	X vector	Y vector	Z vector
-1	.39437	.28972	.10270
199	.39204	.29254	.10360

Basic Date ____
Changed _ July 5, 1969 REV I

P72

SECTION 7. TARGETING

P72 LM CSI TARGETING

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

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

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

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

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

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

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

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

Basic Date April 15, 1969
Changed June 6, 1969

CSM 107 & SUBS

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

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

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

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

     F 06 16   T EVENT

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

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


Basic Date April 15, 1969
Changed June 6, 1969
CR 107 & SUBS

P73

7 F 06 82 ΔV XYZ(LV) (CDH) (.1fps)

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

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

9 F 37

P73 LM CDH TARGETING

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

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

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

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

Basic Date April 15, 1969
Changed JUNE 27, 1969

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

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

4 F 06 81 ΔV XYZ(LV) (CDH) (.1fps)

RECORD (Final Pass Only)
_____(ΔVX)
_____(ΔVY)
_____(ΔVZ)
V90E (Correct out of plane velocity)

F 04 12 R1 00002 Specify vehicle
R2 00001 CSM
00002 LM
PRO

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

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

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

RECORD
_____(Y)
_____(YDOT)
_____(PSI)
PRO

PRO

5 F 16 45 M,TFI,MGA (marks,min-sec,.01°)
(RECYCLE) V32E To 3
(TERMINATE) PRO To 3

Basic Date April 15, 1969
Changed JUNE 27, 1969

C 107 & SUBS

P76

F
7-5/6

(FINAL PASS) SET EVENT TIMER TO TFI
PRO TRANSMIT PARAMETERS
TO LM (See Steps 1-4)

6	F 37		

P76 - TARGET ΔV

1		V37E 76E	
	F 06 84	ΔV XYZ	(.1fps)
		Load ΔV	
		PRO	
2	F 06 33	TIG	(hrs,min,.01sec)
		Load TIG	
		PRO	
3	F 37	OOE	
		V82E (check Lm parameters)	
4	F 16 44	HA,HP, TFF	(.1 nm,min-sec)
		R3 - 59B59HP > 49.4 nm/35K ft	
		PRO	

Basic Date APRIL 15, 1969
Changed JUNE 27, 1969

CSM 107 & SUBS

SECTION 8. EXTENDED VERBS

V35 - DSKY CONDITION LIGHT TEST

CMC - on

1 Key V37E 00E (required)
DSKY - P00

2 Key V35E

3 Monitor the following events

a. All DSKY condition lts - on

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

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

Wait 5 sec

d. All DSKY warning lts - off

e. ISS lt - off
CMC lt - off

f. P00 will be displayed.

g. Key RSET

V41 N91 COARSE ALIGN OCDU's

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

1 V41N 91E

Basic Date APRIL 15, 1969
Changed JUNE 27, 1969

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

V41 N20 COARSE ALIGN ICDU's
CMC - on
ISS - on

1		V41N 20E
2	F 21 22	NEW ICDU ANGLES RPY (.01°) Load desired ICDU angles
3	41	NO ATT lt - on *POSS PROG ALARM * *V5 N9E 211 Coarse align error* *Repeat V41 N20 *
4		V40 N20E NO ATT lt - off Wait 20 sec
5		V37E XXE

V42 GYRO TORQUING
CMC MODE - FREE

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

Basic Date APRIL 15, 1969
Changed JUNE 27, 1969

CSM 7 & SUBS

V48 - DAP ACTIVATION
CMC MODE - FREE

1 V48E

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

	VEHICLE CONFIG	QUAD A/C FOR $\ddot{X}$	QUAD B/D for $\ddot{X}$	ERR DEADBAND	RATE SELECT
R1	0 = No DAP 1 = CSM 2 = CSM & LM 3 = CSM & SIVB 6 = CSM & LM (Ascent Stg only)	0 = Fail A/C 1 = Use A/C	0 = Fail B/D 1 = Use B/D	0 = $\pm$ 0.5° 1 = $\pm$ 5.0°	0 = 0.05°/sec 1 = 0.2°/sec 2 = 0.5°/sec 3 = 2.0°/sec
	Roll Quad Select	Quad A	Quad B	Quad C	Quad D
R2	0 = Use B/D 1 = Use A/C	0 = Fail 1 = Use	0 = Fail 1 = Use	0 = Fail 1 = Use	0 = Fail 1 = Use

PRO

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

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

4 V46E to activate, if req.

Basic Date APRIL 15, 1969
Changed MAY 14, 1969

CSM 107 & SUBS

V49 CREW DEFINED MANEUVER

CMC - on
ISS - on
SCS - operating

1 V37E 00E
V62E

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

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

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

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

V55 - CMC TIME UPDATE

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

V64 HI GAIN ANTENNA POINTING

1 V37E 00E
2 V64E
F 06 51 RHO, GAMMA (.01°,.01°)
HGA TRACK - MAN
Set in required P&Y Angles
S BD ANT - HI GAIN
TRACK - AUTO
PRO

Basic Date APRIL 15, 1969
Changed MAY 14, 1969
CSM 7 & SUBS

V67 - W-MATRIX ERROR DISPLAY

1 V67E

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

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

Load desired data

To reinitialize Cislunar W-matrix,

Load: R1 ~~+03300~~ + 30000
R2 ~~+00033~~ + 00330
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)

V82 ORBIT PARAMETER DISPLAY

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

1 V82E (If AVE G On, Go To 2)

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

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

(RECYCLE) V32E To 2 (Not Nec If AVE G On)
(ΔR-miss dist DISP-P11 & P00) N50E To 3
(TF PER) N32E To 4
(EXIT) PRO

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

4 F 16 32 TIME FROM PER (Useful only if TFF=-59B59)
(hrs,min,.01sec)
KEY RLSE To 2

V83 RNDZ PARAMETER DISPLAY #1

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

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

V85 - RNDZ PARAMETER DISPLAY #2

Note: See V83 restrictions

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

V87 - SET VHF RNG FLAG

VHF - ON
P20 - running

1 V87E (starts VHF range sampling)

2 V88E (TERMINATE)
or V37E XXE

Basic Date — April 15, 1969
Changed — June 6, 1969
107 & SUBS

V89 - RENDEZVOUS FINAL ATTITUDE

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

1		V37E 00E	
		V62E	
2		V89E	
	F 04 06	R1 00003 SPECIFY TRACKING ATTITUDE	
		R2 00001 (PREF)	
		00002 (+X AXIS)	
		PRO	
3	F 06 18	FINAL FDAI RPY ANGLES	(.01°)
		(AUTO MNVR) PRO	
		(UPDATE DISPLAY) V32E	
4	F 50 18	REQ MNVR TO FDAI RPY ANGLES	(.01°)
		(AUTO) BMAG MODE (3) - RATE 2	
		SC CONT - CMC	
		CMC MODE - AUTO	
		PRO	
		(MAN) MNVR To 6	
5	06 18	AUTO MNVR TO FDAI RPY ANGLES	(.01°)
6	F 50 18	REQ MNVR TO FDAI RPY ANGLES	(.01°)
		(TRIM) ALIGN SC In ROLL	
		PRO To 5	
		(BYPASS) ENTR	

V90 - OUT-OF-PLANE DISPLAY

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

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

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

V91 - COMPUTE BANKSUM

CMC - on (req)

1 V37E 00E

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

V93 - ENABLE W-MATRIX INITIALIZATION

1 V93E

Basic Date APRIL 15, 1969
Changed JUNE 27, 1969

CS' 07 & SUBS

SECTION 9. SCS GENERAL

SCS POWER UP

AUTO RCS SELECT (16) - OFF
BMAG MODE (3) - RATE 2
CMC MODE - FREE
SC CONT - CMC
cb SCS LOGIC PWR (4) - close
ΔV CG - as required
LOGIC PWR 2/3 - on (up)
SIG COND/DRIVER BIAS PWR (2) - AC1
SCS ELEC PWR - GDC/ECA (170 watts)
FDAI PWR - OFF (verify)
BMAG PWR (2) - ON (110 watts)
FDAI PWR - BOTH (104 watts)
AUTO RCS SELECT (16) - enable

SCS POWER DOWN

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

Basic Date April 15, 1969
Changed June 6, 1969

GDC ALIGNMENT TO IMU GIMBAL ANGLES

IMU - on
SCS - operating

1 Damp vehicle rates

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

SCS ATTITUDE REFERENCE COMPARISON

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

1 Key V16 N20E (press IMU angs)

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

BACKUP GDC ALIGNMENT (IMU FAILED)

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

1 Set SCT to 180° SHFT, 7.5° TRUN

Basic Date April 15, 1969
Changed June 6, 1969
CSM 107 & SUBS

2 ATT SET dials - R,P,Y ALIGN

3 MNVR to STARS
R line - Vega (36)
50° mark - Deneb (43)

or

	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

To Roll about Z:

1 Set SCT to 180° SHFT, 7.5° TRUN
Sh 180°
Trun 7.5°

2 ATT SET dials - R,P,Y ALIGN
Star 50°
FDAI SELECT - 1/2

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

4 MNVR to STARS
R line - Vega (36)
50° mark - Deneb (43)

or

	NORTH	SOUTH
R line -	Polaris (5)	Atria (34)
50°mark -	Navi (3)	Acrux (25)

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

Basic Date April 15, 1969
Changed May 20, 1969

CSM 107 & SUBS

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 12	00002 SPECIFY VEHICLE
		00001
		PRO

Basic Date April 15, 1969
Changed May 20, 1969

CSM 107 & SUBS

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

4 V83E
F 16 54 R,RDOT,THETA (.01nm,.1fps,.01°)
MODE - HOLD/FAST
SLEW - To THETA
MODE - OPR/SLOW
PRO

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

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

2 MSFN Supply Altitude
ALT SET - Set

3 SC +X At the Horizon

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

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

1 V37E 52E

2 F 04 06 00001
V22E 3E
PRO

3 F 50 25 00015
ENTR

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

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

PASSIVE THERMAL CONTROL (G&N)

RHC - Locked
FDAI SCALE - 5/1

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

2 F 06 22 Load V06N22 With Desired Initial Attitude
PRO R = Present Roll, P = 90° or 270°, Y = 0 } assuming PTC REFSMMAT

3 F 50 18 BMAG MODE (5) - RATE 2
SC CONT - CMC
CMC MODE - AUTO
PRO

4 06 18 AUTO MANEUVER
F 50 18

Basic Date April 15, 1969
Changed June 6, 1969

CSM 107 & SUBS

C&D
Lowest 2 adj. QUADS
Compatible with
DAP roll quads selected

5 ~~Damp vehicle rates:~~
ENTR
PNL 8: Disable all jet on two adjacent quads
START DET → Wait 20 minutes for rates to damp
MAN ATT (PITCH & YAW) - ACCEL CMD
Enable all jets
BMAG MODE (3) - RATE 2

DO NOT MONITOR V16N20

6 Set att hold:
V21N01E
1332E
00000E

7 Select roll rate

+0.1°/s	-0.1°/s	+.3°/s	-.3°/s
V24N01E	V24N01E	V24N01E	V24N01E
3125E	3125E	3125E	3125E
00003E	77774E	00012E	77765E
24400E	53400E	35400E	42400E
V21E	V21E	V24E	V24E
3176E	3176E	3175E	3175E
35101E	42676E	00002E	77775E
		27303E	50474E

8 Start roll maneuver
V21N01E
1332E
70000E

9 Set DBD
V21N01E
3255E

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

11 TO DISABLE RCS:
AUTO RCS SEL (16) - OFF
ROT CONTR PWR DIR (2) - OFF

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

Basic Date — April 15, 1969
Changed — ~~April~~ 27, 1969

CSM 107 & SUBS

To exit G&N PTC AUTO RCS SEL(12)-MNA/B

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

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

For simple termination:
V37E XXE
MAN ATT (3) - RATE CMD

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

1		MNVR TO PTC ATT V62E	
2		V49E	
3	F 06 22	DESIRED FINAL GMBL ANGLES LOAD R,P,Y PTC PRO	(.01°)
4	F 50 18 (AUTO)	REQ MNVR TO FDAI R,P,Y ANGLES SC CONT - CMC CMC MODE - AUTO PRO	(.01°)

Basic Date April 15

Basic Date April 15, 1969
Changed July 27, 1969

CSM 107 & SUBS

(MAN) SC CONT - SCS
MNVR to 6

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

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

7 Initiate .1°/sec roll rate

8 TERMINATE PTC

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

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

Basic Date -- April 15, 1969
Changed ——— June 6, 1969

DOCKED IMU ALIGN

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

Basic Date— April 15, 1969
Changed— June 6, 1969

1 107 & SUBS

SECTION 10. SYSTEMS MANAGEMENT

Basic Date April 15, 1969
Changed JUNE 27, 1969
CSM 107 & SUBS

PROPULSION SYSTEM

1 SPS MONITORING CHECK

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

2 SM RCS MONITORING CHECK

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

3 CM RCS MONITORING CHECK

CM RCS PRPLNT tb (2) - bp
RCS IND sw - CM 1,2
He TEMP - 60-90°F
He PRESS - 4100-4200 psia
MANF PRESS - 25-105 psia
(287-302 after activation)
CM RCS HTRS - OFF (on 20 min prior to pressurization if req'd)

EPS SYSTEM

1 Cryogenic Pressure - Quantity Check

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

2 FC Power Plant Check

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

3 D-C Voltage-Amperage Check

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

4 A-C VOLTS - 113 to 117 all phases

5 Battery Charging BAT A(B)

cb ECS RAD HTRS OVLD - close (verify)
MAIN BUS TIE A/C (B/C) - OFF
cb BAT BUS A & B PYRO BUS TIE - open (verify)

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

6 Fuel Cell Power Plant Purging

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

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

7 H2 or O2 Quantity Balance Correction

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

8 FUEL CELL SHUTDOWN (APPLICABLE FC)

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

CSM 107 & SUBS Basic Date APRIL 15, 1969
Changed JUNE 1969

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

9 FUEL CELL SWITCHING

PRIOR TO DISCONNECTING, INSURE THAT AT LEAST ONE FUEL CELL IS POWERING EACH MAIN BUS
Possible MA & FC DISCONNECT lt

10 INVERTER CHANGEOVER

A. One inverter on each AC bus at all times (if available)
B. If all three AC bus ties for the same bus are on, inverter power to that bus may be lost
C. When switching DC power on inverter 3, pause in OFF position

11 CRYO 02 & H2 MANUAL FAN OPERATION

H2 & 02 FANS - ON (seq at 1 sec intervals for 1 min each)
a. Prior to every SPS or SIVB ΔV
b. Presleep
c. Postsleep

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

ECS PERIODIC VERIFICATION

1 ECS MONITORING CHECK

CABIN ΔP - -1 to -3.5 in H2O
02 FLOW - 0.2-0.45 lb/hr (after changeover)
02 SURGE TANK PRESS - 865-935 psia
REPRESS 02 >865 psia
PRIM RAD tb - gray

Basic Date APRIL 15, 1969
Changed JUNE , 1969
CSM 107 & SUBS

*If PRIM RAD tb - 2 *
* ECS RAD FLOW AUTO CONT - 1 until *
* tb gray, then AUTO *
ECS RAD TEMP PRIM IN - 67-97° F
ECS RAD TEMP PRIM OUT - -20° to +63° F (-20° to 97° F for lunar orb)
PRIM GLY EVAP TEMP OUT - 40-50.5°F
PRIM GLY EVAP STEAM PRESS
.1-.15 boiling, > .16 not boiling
PRIM GLY DISCH PRESS - 40-52 psig
SUIT TEMP - 45-55° F
CABIN TEMP - 70-80° F
SUIT PRESS/CABIN PRESS- 4.7-5.3 psia (14.7 for launch)
PART PRESS CO2 < 7.6 mm Hg
SUIT COMP ΔP - 0.3-0.4 psid
PRIM GLY ACCUM QTY 30-65% (expect 20-50% at insert)
*If <30% - PRIM ACCUM FILL vlv - *
* ON (Until 40-55%) *
POT H2O QTY - 10-100%
*If<25% *
POT TK IN vlv - OPEN
WASTE H2O QTY - 25-85%
If >85% - Dump

2 ECS PERIODIC REDUNDANT COMPONENT CK

Suit Compressor
Sw to other compr
SUIT COMPR ΔP ind - 0.3-0.4 psid
Main O2 Regulators
MAIN REG B vlv - close
EMER CABIN PRESS sel - 1
PUSH TO TEST PB - PUSH (O2 FLOW INC)

MAIN REG B vlv - open
MAIN REG A vlv - close
EMER CABIN PRESS sel - 2
PUSH TO TEST PB - PUSH (O2 FLOW INC)

MAIN REG A vlv - open
EMER CABIN PRESS sel - BOTH (OFF if all suited)
Secondary Glycol Loop
Open cool atten panel (If req'd)

EVAP H2O CONT SEC vlv - AUTO
ECS IND sw - SEC
SEC COOL LOOP PUMP - AC 1 (AC 2)
  GLY DISCH SEC PRESS - 39-51 psig
  ACCUM SEC QTY IND - 30-55%
SEC COOL LOOP EVAP - EVAP
SEC EVAP STEAM PRESS .1-.15 boiling,
  >.16 not boiling
After 5 min
  SEC EVAP TEMP OUT - 40-50.5°F
SEC COOL LOOP EVAP - RESET for 1 min minimum,
  then off (ctr)
Wait 2 min
SEC COOL LOOP PUMP - off (ctr)
ECS IND sw - PRIM

3 CO2 ABSORBER FILTER REPLACEMENT

Open CO2 Canister attenuation pnl

CAUTION

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

CO2 CSTR DIVERT vlv - up (or dn)

CAUTION

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

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

Basic Date — April 15, 1969
Changed — June 27, 1969

107 & SUBS

4 GLYCOL ACCUMULATOR REFILL (IF <30%)
PRIM ACCUM FILL vlv - ON
GLY ACCUM PRIM QTY - 40-55%
PRIM ACCUM FILL vlv - OFF
IF OVER FILL
GLYCOL RESVR INLET - OPEN (MOM)

5 DEBRIS SCREEN CHECK
Check cabin ht exch inlet screen
Check SUIT RET AIR vlv screen
SUIT RET AIR vlv - CLOSE (push)
Clean screens
SUIT RET AIR vlv - OPEN (pull)

6 CM O2 SUPPLY REFILL
SURGE TANK PRESS ≥500 psia
CAB REPRESS vlv - OFF
REPRESS O2 vlv - CLOSE
REPRESS PKG vlv - FILL
SURGE TANK PRESS - 865-935 psia
O2 PRESS IND - TANK 1
REPRESS PKG vlv - OFF

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

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

Basic Date April 15, 1969
Changed June 27, 1969

CSM 107 & SUBS

9 PARTIAL SUIT CKLIST

EMER CAB PRESS vlv - BOTH
SUIT CKT RET vlv - OPEN (pull)
Reverse 02 umbilicals
Before disconnecting umbilical from head set:
SUIT PWR - OFF
POWER - OFF
AUDIO CONT - NORM

10 URINE DUMP MODES USING UTS

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

B UTS (Collection)
Obtain UTS & verify vlv - CLOSED
Attach UTS - open vlv - Perform task
UTS vlv - CLOSED
Disconnect UTS & stow

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

Basic Date April 15, 1969
Changed June 27, 1969

CR 107 & SUBS

11 CABIN PRESSURIZATION

A NORMAL 30 min

CAB PRESS REL vlv (2) - NORMAL (latch on)
MONITOR SURGE TANK PRESS
REPRESS PKG vlv - FILL
REPRESS O2 vlv - OPEN
AT 150 psia on SURGE TANK:
  REPRESS PKG vlv - OFF
  CABIN REPRESS vlv - Adjust to 150 psia on SURGE TANK
AT ZERO psia on EMERG O2 GAUGE:
  REPRESS O2 vlv - CLOSE
CAB REPRESS vlv - OPEN
WHEN CABIN PRESS = 4.7-5.3
  O2 PRESS ind - TANK 1
  CAB REPRESS vlv - OFF

B ALTERNATE, 52 min

CAB PRESS REL vlv (2) - NORMAL (Safety latch on)
EMER CAB PRESS vlv - BOTH
CAB REPRESS vlv - OPEN
MONITOR SURGE TANK PRESS
At 150 psia on SURGE TANK:
  EMER CAB PRESS vlv - OFF
  CAB REPRESS vlv - Adj to 150 psia on SURGE TK
WHEN CAB PRESS $\geq$4.7
  O2 PRESS IND - TANK 1
  CAB REPRESS vlv - OFF

12

(DELETED)

13 SUIT CKT INTEGRITY CHECK

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

CAUTION

SUIT TEST vlv should remain

Basic Date April 15, 1969
Changed June 27, 1969

CSM 107 & SUBS

in the PRESS position until suit circuit pressure is stabilized to preclude seal scarring. If repositioning of SUIT TEST vlv from PRESS is required prior to suit pressure and 02 flow stabilization, perform the following:

a. 02 DEMAND REG vlv - OFF
b. Allow 15 sec (min) stabilization time
c. Reposition SUIT TEST vlv - DEPRESS or OFF as applicable
d. When suit pressure stabilized, 02 DEMAND REG vlv - BOTH

SUIT TEST vlv - PRESS
02 FLOW - 1.0 lb/hr (pegged)
02 FLOW HI lt - on
M/A - ON, Reset

SUIT PRESS - 8.8-9.8 psia
PGA PRESS - 4.1-4.5 psig
02 FLOW HI lt - out
Allow 02 flow to stabilize 15 sec
02 flow will remain below 0.8 lb/hr for 30 sec after stabilization
SUIT TEST vlv - DEPRESS
02 FLOW - 0.2-0.4 lb/hr
SUIT PRESS - slightly > CAB PRESS
SUIT TEST vlv - OFF
02 DEMAND REG vlv - BOTH (verify)

14 PGA INTEGRITY CHECK
DIRECT 02 vlv - CLOSE
SUIT PRESS - 4.7-5.3 psia
02 FLOW - 0.2-0.4 lb/hr

CAUTION

pg F/10-9

CSI 07 & SUBS
Basic Date April 15, 1969
Changed June 27, 1969

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

WARNING

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

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

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

CAB PRESS REL vlv (RH) - DUMP
  CABIN PRESS - 0.0 psia (within 6 min)
CAB PRESS REL vlv (2) - NORMAL (latch on)

16 SUIT CKT H2 PURGE
DIRECT 02 vlv - OPEN for 1 min
  02 FLOW - 1.0 lb/hr (pegged)
  02 FLOW HI lt - on
  MASTER ALARM pb/lt (3) - on, push
DIRECT 02 vlv - CLOSE
  02 FLOW HI lt - out
  02 FLOW - 0.2 lb/hr

17 CABIN COLD SOAK
ACTIVATE
SUIT HT EXCH SEC GLY vlv - FLOW
EVAP H2O CONT SEC vlv - AUTO
GLY TO RAD SEC vlv - BYPASS (verify)
CAB TEMP - MAN
PRIM CAB TEMP vlv - C (CW)
SEC CAB TEMP vlv - OFF
SUIT CKT HT EXCH - BYPASS (20sec), then OFF

ECS IND sel - SEC
SEC COOL LOOP PUMP - AC2
GLY DISCH SEC PRESS - 39-51 psig
SEC ACCUM QTY - 30-55%
SEC COOL LOOP EVAP - EVAP
SEC GLY EVAP OUT TEMP - 40-50.5°F
SEC GLY EVAP STM PRESS - 0.1-0.15 psia,
  >.16 not boiling
ECS IND - PRIM
PRIM ECS RAD OUT TEMP - >-20°F
  IF <-20°F, DEACTIVATE

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

18 ACTIVATE PRIMARY EVAP
GLY EVAP H20 FLOW - AUTO
GLY EVAP STM PRESS - AUTO

DEACTIVATE PRIMARY EVAP
GLY EVAP H20 FLOW - off (ctr)
GLY EVAP STM PRESS AUTO - MAN
GLY EVAP STM PRESS INCR - INCR for 1 minute

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

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

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

CK WASTE TK QTY; IF < 15% NO CHLORINATION IF EVAPORATORS OPERATING
CK POT TK QTY; IF ≥90% WITHDRAW 8OZ. OF WATER

20 POTABLE WATER CHLORINATION
Unstow chlorination unit
Remove chlor port cap
Attach needle assembly to injection port
Insert chlorine ampoule into casing
Connect knob assembly & rotate (CW) until piston contacts ampoule
Install ampoule assembly on needle assembly (push & turn CW)
Rotate knob (CW) until ampoule is empty (3 times for half empty if H20 quantity <50%)
Disconnect ampoule assembly from needle assembly
Rotate knob CCW & stow used ampoule

Repeat above steps with buffer ampoule
POT [redacted] IN vlv - OPEN (verify)
Wait 10 min & remove ampoule of H2O
Replace chlor port cap
Stow chlorination unit
Do not drink for 30 min

21 WASTE WATER TANK DRAIN

H2O QTY IND sw - WASTE
POTABLE TANK INLET - CLOSE
WATER CONT PRESS REL vlv - DUMP A
Monitor H2O QTY (WASTE) ind - decreasing
When H2O QTY (WASTE) ind reads 25%:
  WATER CONT PRESS REL vlv - 2
POTABLE TANK INLET - OPEN

22 SIDE HATCH URINE/WATER DUMP

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

23 WATER COLLECTION

Connect urine transfer hose-filter to urine/feces QD
Connect cabin purge QD to urine transfer hose
WASTE MANAGEMENT DRAIN vlv - DUMP
Collect water

Basic Date — April 15, 1969
Changed — June 6, 1969
CSD 07 & SUBS

After collection complete:
Purge for 1 minute (min)
WASTE MANAGEMENT DRAIN vlv - CLOSE

SUIT CKT RET VLV - CLOSE
DEMAND REGS - OFF

24 CONTAMINATION CONTROL

ALL SUIT ~~RET~~ ~~LMP SUIT~~ T FLOW vlv - ~~CBT~~ FULL FLOW
Install interconnect on L~~MP~~ 02 ~~inlet~~ R hose
Install vacuum cleaner brush on R~~MP~~ 02 red hose
INSTALL ~~LMP SUIT FLOW vlv - CABIN~~ SCREEN ON C 02 R HOSE
Vacuum/brush CM interior with special
attention to the following:
Transfer tunnel wall and top hatch surfaces
Open B5 and B6 cover and clean compartment and SRC bags surfaces
Open A5 and clean compartment and CSC bag and film cassette bags surfaces
Open R13 and clean compartment and film magazine bag surface
Open food containers and clean compartment and helmet stowage bags surfaces
PGA bag surfaces
Move vacuum cleaner brush into all potential "dead air" pockets to ensure thorough scrubbing of CM atmosphere by LiOH canisters
Change routing of hoses to establish new 02 flow pattern in CM for next 24-hour period
SUIT CKT RET VLV - OPEN
DEMAND REGS - BOTH
C/W SYSTEM

A C/W SYSTEM OPERATIONAL CHECK
C/W LAMP TEST-1 (LH MA & 16 lts)
C/W LAMP TEST-2 (RH MA & 23 lts)
C/W CSM-CM (CM RCS lt(2)-on)
C/W CSM-CSM(CM RCS lt(2)-out)

B ACKNOWLEDGE/RESET MASTER ALARM INDICATION
a. Normal mode
MA tone/lt(3)-on
MA pb/lt(1)-push
MA tone/lt(3)-out
applicable C/W lt remains on

NOTE: IF MASTER ALARMS DUE TO REPORTED O_2 HIGH FLOW BECOME BOTHERSOME, DEACTIVATE BY PULLING CB PNL 5: ECS TRANSDUCER PRESS GP 2 MN B

Basic Date ~~April~~ 15, 1969
Changed ~~June~~ 6, 1969

CSM 107 & SUBS

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

C MASTER ALARM TONE HEADSET CONTROL

a. Inhibit tone (PWR-AUDIO)

b. Permit tone (PWR-AUDIO/TONE)

TELECOMM PROCEDURES

1 HI-GAIN ANTENNA OPERATION

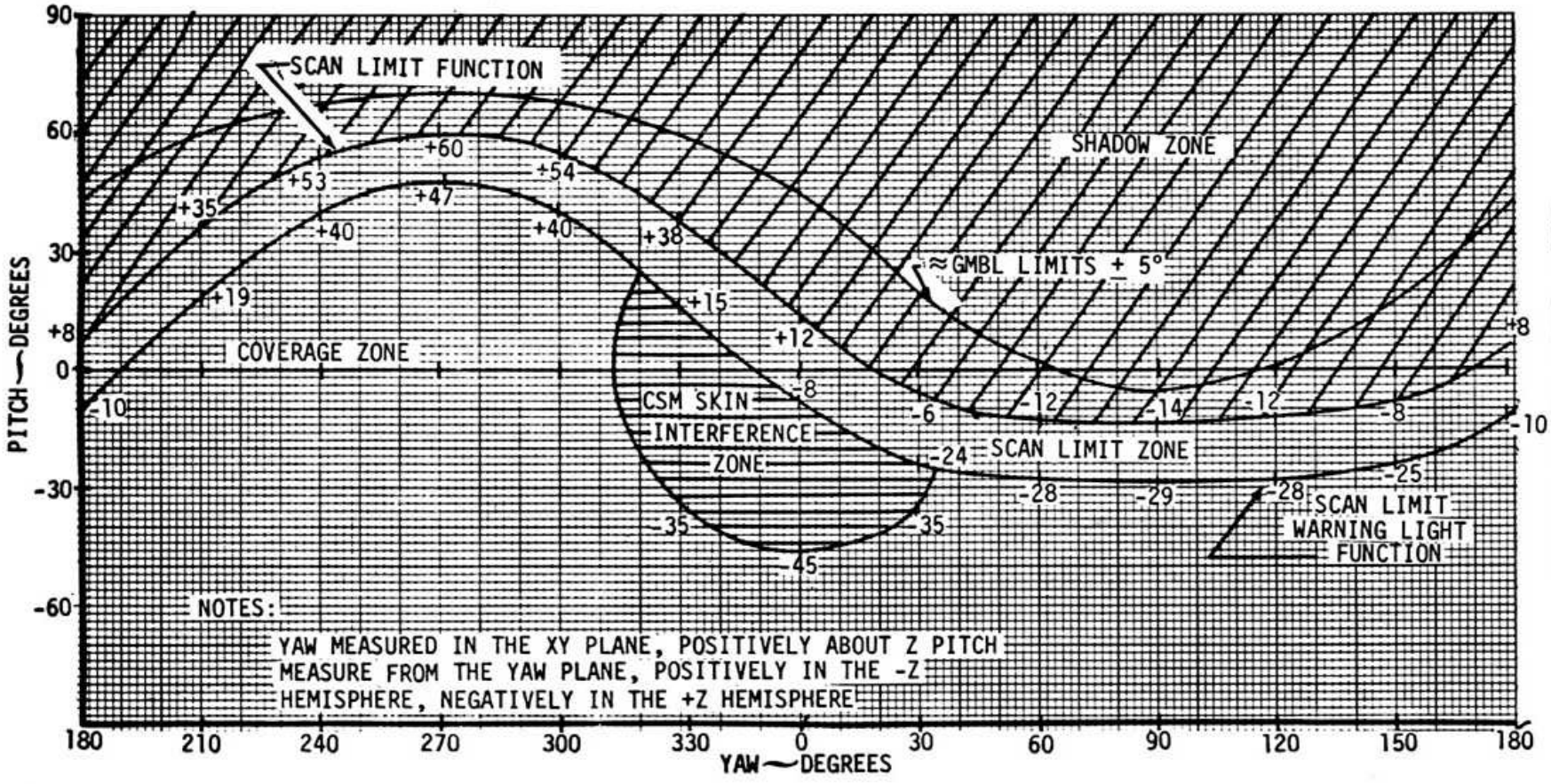
cb HI-GAIN ANT FLT BUS - closed
cb HI-GAIN ANT ac GRP 2 - closed
HI-GAIN ANT TRACK - MAN
HI-GAIN ANT SERVO ELEC - PRIM
HI-GAIN ANT BEAM - WIDE
HI-GAIN ANT PWR - POWER
Go to V64 START S-BAND ANTENNA procedures
Verify required coordinates within full coverage region

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

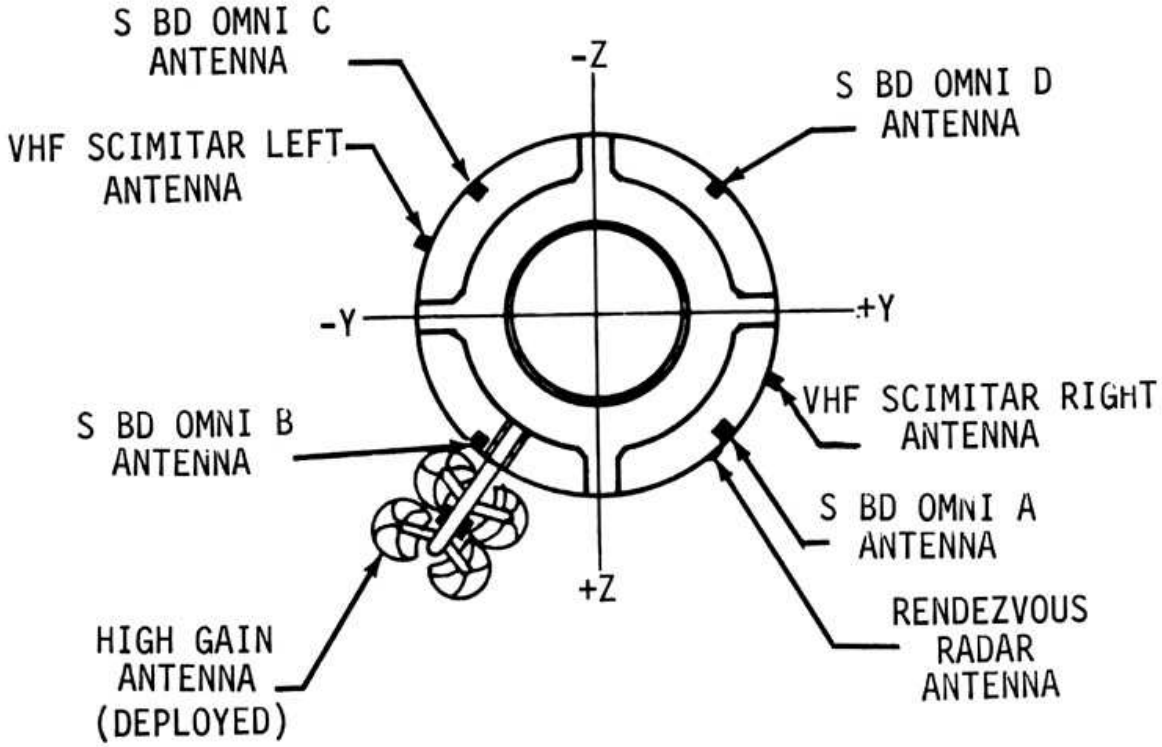
HI-GAIN ANT PITCH & YAW POS (2) - Set in required coordinates

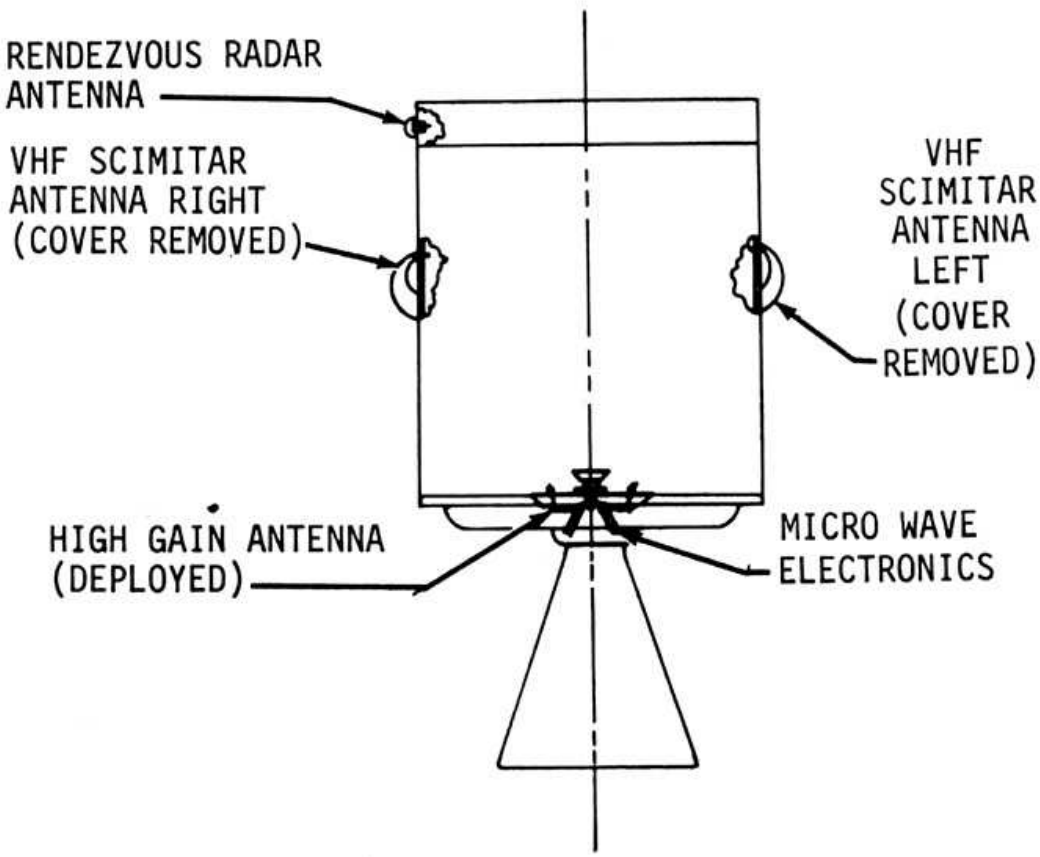
Basic Date— April 15, 1969
Changed— June 6, 1969

CSM 107 & SUBS



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





Basic Date- April 15, 1969
Changed June 6, 1969

107

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

2 TV CAMERA OPERATION (BLACK & WHITE)

Unstow camera, optical sight, lens, lens attenuator and cables
S BD AUX TAPE - off (ctr) or DN VOICE BU
S BD AUX TV - off
Connect power and RF cables
Install proper lens
  (telephoto out of focus at < 143 ft)
  (wide angle out of focus at < 18 in)
Attach light attenuator to lens
Install optical ring sight
S BD AUX TV - TV
ALC (camera) - IN (normally)
  OUT(when detail on dim objects in presence of bright objects is desired)
Power (camera) - ON
Adjust light attenuator (lower numbers less)
When TV operation is completed -
  Power (camera) - OFF
  S BD AUX TV - off (center)
  Disassemble and stow equipment as desired

2A TV CAMERA OPERATION (COLOR)

Unstow TV camera, monitor, camera cable, and monitor cable
TAPE RCDR FWD - off (ctr)
Verify tb - bp; if gray, notify MSFN to reset all tape recorder RTC's
cb FM XMTR/GRP 1 - open
Verify monitor power sw is in off position

Basic Date — April 15, 1969
Changed — June 6, 1969
CSM 107 & SUBS

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

3 VHF RANGING OPERATION

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

CAUTION

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

VHF RNG - RESET
EMS RANGE ind - 000 00
P20 operating, TRACKER lt - out
EMS RANGE ind - XXX XX

Basic Date— April 15, 1969
Changed— June 6, 1969
CSM 107 & SUBS

V83E (if desired)
R1 = RANGE
R2 = RANGE RATE
R3 = θ
V85E (if desired)
R1 = RANGE
R2 = RANGE RATE
R3 = Ø

4 RNDZ XPNDR ACTIVATION & SELF TEST

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

5 COMM MODES

NORMAL LUNAR CONFIGURATION

S BD XPNDR - PRIM
S BD PWR AMPL - PRIM
S BD PWR AMPL HI - HI
S BD MODE VOICE - VOICE
S BD MODE PCM - PCM
S BD RNG - RNG
S BD AUX TAPE - DN VOICE BU
S BD AUX TV - off (ctr)
UP TLM DATA - DATA
UP TLM CMD - NORM
VHF AM A - off (ctr)
VHF AM B - off (ctr)
VHF RCV ONLY - off (ctr)

Basic Date — April 15, 1969
Changed — June 27, 1969
CSM 107 & SUBS

VHF RNG - OFF
TAPE RCDR PCM - PCM/ANLG
TAPE RCDR RCD - RCD
TAPE RCDR FWD - FWD
SCE PWR - NORM
PMP PWR - NORM
PCM BIT RATE - LOW
S BD SQUELCH - OFF
HI GAIN ANT PWR - PWR
HI GAIN ANT TRACK - MAN
HI GAIN ANT BEAM - WIDE
HI GAIN ANT SERVO ELEC - PRIM

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

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

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

C. LUNAR ORBIT AWAKE
USE NORMAL LUNAR CONFIGURATION

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

Basic Date Apr 15, 1969
Changed June 27, 1969

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

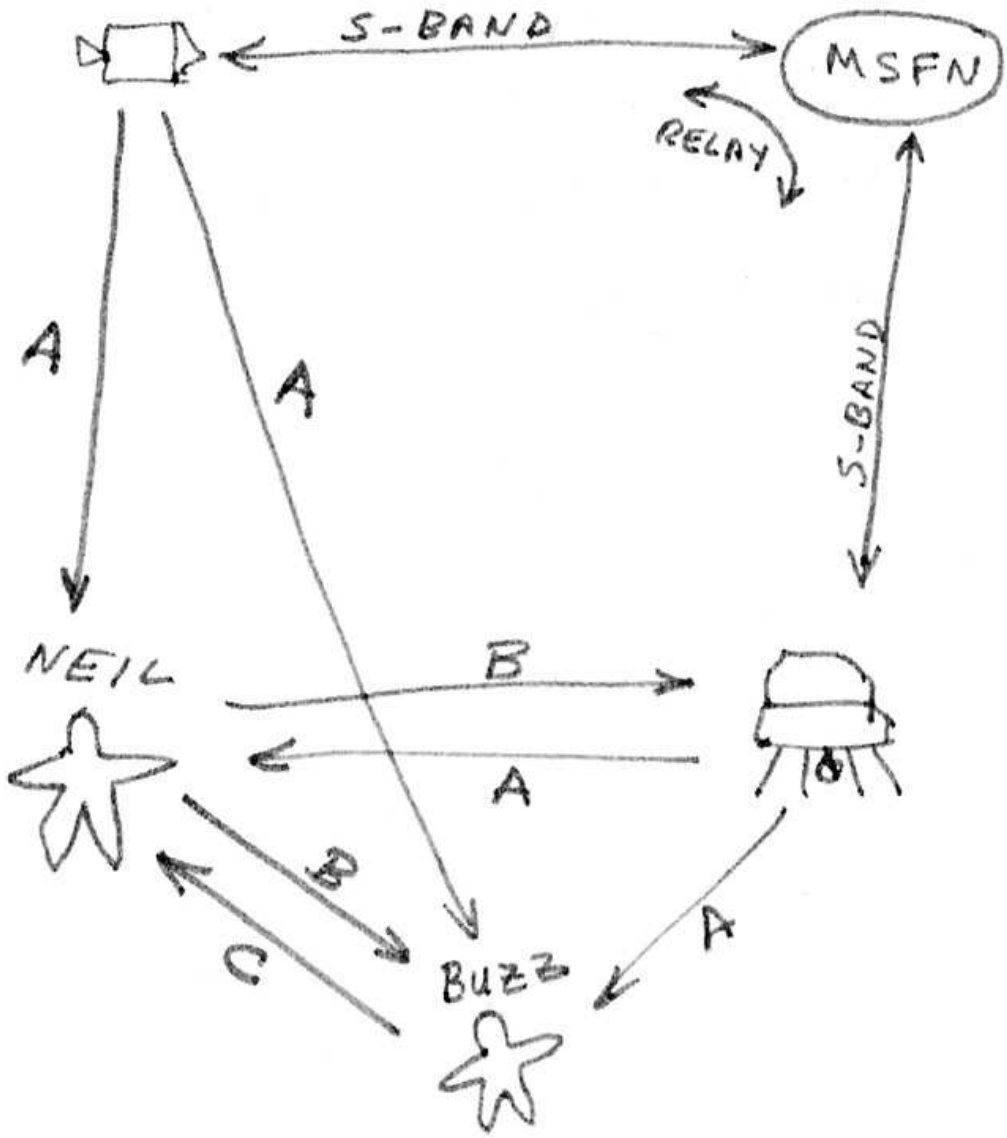
E. VHF RANGING, VOICE
VHF AM A - off (ctr)
VHF AM B - DUPLEX
VHF RNG - RNG
VHF RCV ONLY - B DATA (MINIMIZES CREW SWITCHING)

F. VHF LM-CSM VOICE DATA
VHF AM A - SIMPLEX
VHF AM B - off (ctr)
VHF RCV ONLY - B DATA

G. CONTINGENCY ~~EVA~~ SIMPLEX A
~~VHF AM A - DUPLEX~~ SIMPLEX B

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

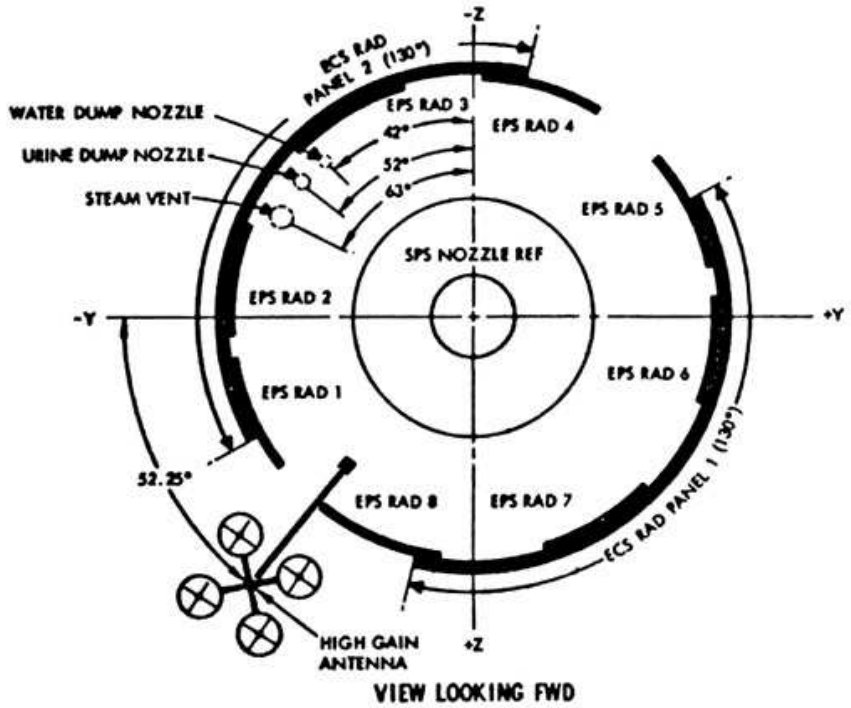
Voice Relay (With LM LBR PCM record)
MODE - VOX (Pnl 10)
VOX SENS tw - 5
S BD - OFF (Pnl 10)
INTERCOM - OFF
VHF AM - T/R
AUDIO CONT - BU
MODE - VOX (Pnl 9)
VOX SENS tw - as req
S BD MODE VOICE - RELAY
VHF RCV ONLY - B DATA

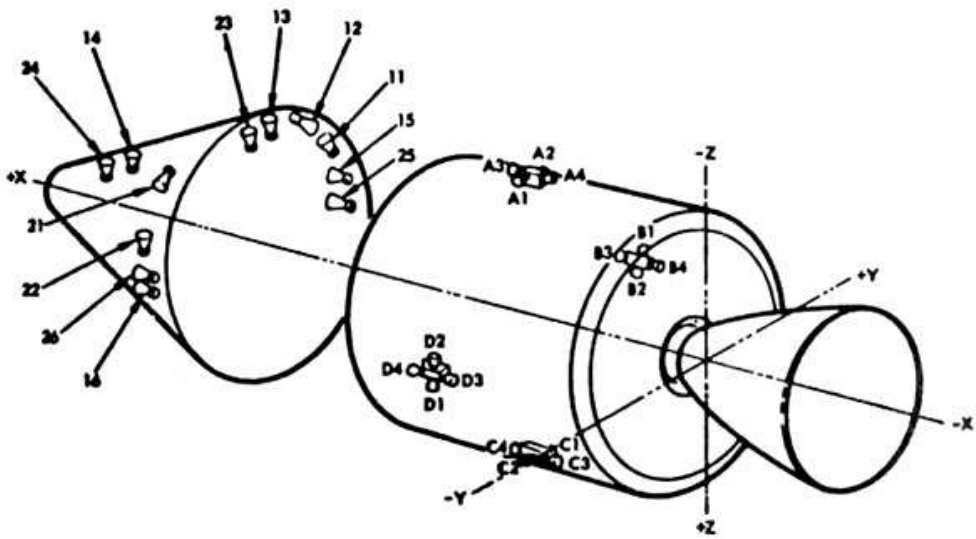


PRIVATE LOOP TO EVA:
WHEN AOS LM, S-BAND T/R TO R
VHF SIMPLEX A TO T/R

TO TALK TO GND W/O BOTHERING LM,
REQUEST MSFN RELAY OFF

Basic Date April , 1969
Changed June , 1969





RCS Engine, Vent, and Radiator Location

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

SECTION 11. LM INTERFACE

Basic Date April 15, 1969
Changed J 27, 1969

1 IVT TO LM FOR FIRST & SECOND ENTRY

Couches: CDR - 0°, CMP - 0°, LMP - 180°
TUNL LTS - ON
TUNL VENT v1v - LM/CM ΔP
Verify LM/CM ΔP <0.2
*LM/CM ΔP >0.2 *
Equalize CM/TUNL pressure
*(DECAL) *

Remove hatch & stow (Decal) (3)
Remove probe & stow (Decal) (4)
Remove drogue & stow (Decal) (5)
Read docking tunnel index angle _____
Open LM hatch
LMP Transfer to LM (6)

FOR LM ACTIVATION

At LM request
LM PWR - RESET, then OFF
SYS TEST - 4D
SYS TEST ind - 0 volts
Perform comm checks with LM

At LM request
LM PWR - CSM
SYS TEST - 4D
SYS TEST ind - 0.5 - 3.2 volts

LMP Transfer to CSM (6A)
Close LM hatch
Install drogue (Decal) (8)
Install probe (Decal) (9)
Install CM hatch (Decal) (11)
TUNL VENT v1v - LM/CM ΔP
TUNL LTS - OFF

2 IVT TO LM FOR FINAL ENTRY

Couches: CDR- 0°, CMP- 0°, LMP- 180°
CDR don LCG & PGA
Don helmet protective shield (if req'd)
Suit Integrity Ck (if req'd)
TUNL LTS - ON
TUNL VENT v1v - LM/CM ΔP
Verify LM/CM ΔP <0.2
*LM/CM ΔP >0.2 *
* Equalize CM/TUNL Pressure*
*(DECAL) *

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

CDR transfer to LM (6)
LMP transfer to CSM (6A)
LMP don LCG & PGA
LMP transfer to LM (6)
Remove LM umbilicals (7)
Install drogue (Decal) (8)
Install probe (Decal) (9)
Preload probe (Decal) (10)
LM hatch closed
Verify CSM roll cmds inhibited
until LM/CM ΔP ≥3.5 psid (>3.5,2 jet; >4, 4 jet)
Cock docking latches (12) (I) (J)
Verify hook is clear of LM ring

*Hook does not release: *
* AUX REL (yellow) - push *
* Cock latch *

Install tunnel hatch (Decal) (11)
Perform hatch integrity check (Decal) (12)
Remove center couch and stow
Install docking target
DOCKING TARGET - BRIGHT
Receive target alignment verification from LM
Configure side hatch for EVT
ACTR HANDLE SEL - N (neutral)
GN2 VLV HANDLE - pull (inboard)
GN2 PRESS ind - minimum

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

Basic Date Apr 15, 1969
Changed Jun 27, 1969

ACTR HNDL SEL - stow
- push to stow
Remove hatch, stow

4 PROBE REMOVAL (CM Side) (Decal)

A. Translunar Docking:

Verify EXTEND LATCH engaged indicator (red) not visible

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

GN2 BLEED button (RED) - press (10 sec)
PRELOAD SEL LEVER - rotate CCW (parallel to orange stripe)
PRELOAD HNDL - Torque (CW) unload support beams

B. Lunar Orbit Docking:

PRELOAD SEL LEVER - rotate CW(away from orange stripe)
PRELOAD HNDL - torque CCW to engage EXTEND LATCH (red indicator not visible)
GN2 BLEED button (red) - press (10 sec)

C. Both TLD & LOD:

PROBE UMBILICALS (2) (yellow) - disconnect and stow
Elec connector covers (2) (yellow) - close
PRELOAD HNDL - position against umbilical connector
PRELOAD SEL LEVER - mid position
INSTALLATION STRUT - unstow, position on tunnel wall (yellow marks)
CAPTURE LATCH RLSE HNDL LOCK - Rotate CCW to unlock (orange stripe visible)
RATCHET HNDL - unstow to full extension
- push to first detent (red band)
- push outbd and hold to fold probe
RATCHET HNDL - pull to full extension
- ratchet one stroke only
Restow RATCHET HNDL and INSTALLATION STRUT
CAPTURE LATCH RLSE HNDL - Pull, rotate to unlock (180° CW) - push to recess

Basic Date April 15, 1969
Changed - June 6, 1969

CSM 107 & SUBS

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

Remove PROBE - pull aft to release (25 lbs)

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

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

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

7 REMOVE LM UMBILICALS (FINAL)
LM Connector Fairings (2) (orange) - open
Connectors (2) - release and remove
Fairings (2) - close
Pull lanyard on LM end of umbilical
Remove umbilicals from tunnel, stow in F1 or F2

8 INSTALL DROGUE (Decal)
DROGUE - Align Lugs with fittings
- Rotate CCW to stops
LOCK LEVER - Rotate 90° CW to detent

Basic Date— April 15, 1969
Changed— June 6, 1969
CSM 107 & SUBS

9 INSTALL PROBE (Decal)
CAPTURE LATCH RLSE HNDL - Pull, rotate CCW to cock pos (150°)
Push PROBE into DROGUE
CAPTURE LATCH RLSE HNDL - rotate CCW to LOCK position (do not force)
- push to recess
Verify capture latches engaged (CDR)
INSTALLATION STRUT - unstow, position on tunnel wall (yellow marks)
RATCHET HNDL - unstow to full extension (green band)
- ratchet probe fwd to orange hash mark
Restow RATCHET HNDL and INSTALLATION STRUT (H)
CAUTION: For stowage, adjust PRELOAD HANDLE until probe loose in tunnel & position at 45° to support beam.
Verify RATCHET PAWL indicator(red)flush with housing

*Ratchet pawl indicator not flush: *
* Hold RATCHET HANDLE full outboard *
* Press Pawl indicator to seat (flush)*
* Release RATCHET HANDLE *

Preload Shaft - push up into detent
CAPTURE LATCH RLSE HNDL - Set in detent
CAPTURE LATCH RLSE HNDL LOCK - Rotate CW to lock (orange stripe not visible)
PROBE UMBILICALS (2) (yellow) - connect to dock ring
NOTE: For stowage, umbilical connection not required.

Basic Date April 15, 1969
Changed June , 1969

10 PRELOAD PROBE (Decal)
PRELOAD SEL LEVER - rotate CCW (parallel to orange stripe)
PRELOAD HNDL - torque (CW) to release (F)
Verify capture latches engaged (CDR)
PRELOAD HNDL - Push inboard to detent
- pos 45° to support beam
PRELOAD SEL LEVER - mid position
Verify CAPTURE LATCH RLSE HNDL LOCK is locked (orange stripe not visible)

11 HATCH INSTALLATION (Decal)
Align Hatch in tunnel
ACTR HNDL SEL - unstow, set to L
- push to stop

Verify gearbox disconnect socket - L

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

ACTR HNDL SEL - stow
- push to stow
PRESS EQUAL vlv - CLOSED (CW) (C)

12 HATCH INTEGRITY CHECK (Decal)
Verify LM Hatch Closed, DUMP vlv - AUTO (CDR)
Verify CABIN PRESS ind - 4.7-5.3 psi
TUNL VENT vlv - TUNL VENT for 30 sec
- LM/CM ΔP, check ΔP
- Recycle to TUNL VENT until ΔP>3.5
≈(≅ 8 1/2 min)

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

Verify LM/CM ΔP ind constant (±.2) at last value for 2 min
Verify O2 FLOW ind - no increase

Before undocking only:
TUNL VENT vlv - LM TUNL VENT
for 10 min, then LM/CM ΔP
Verify LM/CM ΔP >4.0(pegged)
TUNL VENT vlv - OFF
TUNNEL LIGHTS - OFF
Before Jettison only:
TUNL VENT vlv - TUNL VENT (at least 10 min)
TUNNEL LIGHTS - OFF

MALFUNCTION LIST
DOCKING
A. Positive Indication of No Capture
THC -X withdraw to formation
flight distance

Basic Date Apr 15, 1969
Changed Jun 7, 1969

- PROBE EXTD/REL - EXTD/REL for 5 sec
  - RETR
- PROBE EXTD/REL tb(2) - gray (verify)
- Attempt redocking as before

B. One tb does not indicate bp but capture attained
   For retraction, use bottle (1) in system with gray tb
- If no retraction, use bottle (2) in system with gray tb
- If no retraction, use bottle (1) in system with bp tb
- Trouble shoot later before removing probe as follows:
- DOCK PROBE RETRACT (2) - OFF
- cb DOCK PROBE (2) - open
- Interchange probe umbilical connections (cut cable retainers if necessary)
- Cock docking latches #1 and #7
- cb DOCK PROBE (2) - closed
- DOCK PROBE EXTD/REL - RETR
- If previous bp tb is now gray, failure is in probe; interchange umbilicals again. Only one bottle is usable to complete mission.
  If previous bp tb is now bp, failure is in SC wiring. Two bottles are usable to complete mission as connected.
  Manually release docking latches #1 and #7.

Basic Date April 15, 1969
Changed June , 1969

TUNNEL HATCH

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

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

For Subsequent IVT
TUNL VENT v1v - LM PRESS
(May require up to 12 hrs
to equalize pressure)

PROBE

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

F. Preload Ratchet Will Not Drive To Achieve Proper Preload.
- Use Tool F To Drive Hex Fitting On Aft End Of Preload Shaft (CW Direction, 30 To 40 lbs On Tool Handle)

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

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

DOCKING LATCHES

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

Basic Date— April 15, 1969
Changed— June 27, 1969

CS 07 & SUBS

Check w MCC

TUNNEL

J. High O2 Flow While Cocking Docking Latches
- Re-engage/verify 3 latches ~ 120° apart are engaged
- Use Tool F To Drive Hex Fitting On Aft End Of Preload Shaft 180° CW
- Torque preload handle CW until load limiter releases
- Disengage docking latches

SIDE HATCH

K. Cannot latch side hatch (frozen gearbox)
- The Following tools are required: Tool B, tool F, (3) jackscrews
- Install (3) jackscrews to restrain hatch in closed position
- Use tool B to remove (2) clevis pins connecting linkage to gearbox and (1) clevis pin from linkage in corner above gearbox.
- Tighten jackscrews to close hatch as far as possible
- Use tool F on flats of latch bellcrank to drive latch to over-center closed position (Apply tool F to upper latch on hinge side to drive the lower and hinge side linkage closed. Apply tool F to center latch to drive upper linkage closed. Gearbox side linkage may not close if gearbox is in full open position.
- Install (2) clevis pins in threaded holes in linkage bell cranks at upper gearbox side and lower hinge side. (Clevis pins installed when approx. half the threads are visible).

CSM DOCKING

1 cb DOCK PROBE (2) - closed
PROBE RETRACT (2) - OFF (verify)
PROBE EXTD/REL - RETRACT
PROBE EXTD/REL tb (2) - gray (verify)
cb SECS LOGIC (2) - closed (verify)

Basic Date April 15, 1969
Changed June 6, 1969

CSM 107 & SUBS

cb SECS ARM (2) - closed
SECS LOGIC (2) - on (up)
MSFN confirm GO for PYRO ARM
SECS PYRO ARM (2) - ARM

2 At Capture: PROBE EXTD/REL tb - bp (A)
SC CONT - CMC/FREE
Allow Probe to damp SC motion (10 sec)
When within ± 2° of docking attitude
PROBE RETRACT PRIM -2

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

PROBE tb-bp and no dock latch cues:
* PROBE RETRACT SEC - 1 *

4 After Hard Dock: PROBE EXTD/REL - OFF

5 SECS PYRO ARM (2) - SAFE
SECS LOGIC (2) - OFF
cb SECS ARM (2) - open
cb DOCK PROBE (2) - open
BMAG MODE (3) - RATE 2
PROBE RETRACT (2) - OFF
EXT RUN/EVA LT - OFF
EXT RNDZ LIGHT - OFF
COAS PWR - OFF
RNDZ XPNDR - OFF
LIMIT CYCLE - ON
ATT DB - MAX
BMAG MODE (3) - ATT 1/RATE 2
SC CONT - SCS
LOAD DAP: N46: 61102
11111
V46E

LM JETTISON

1 FINAL IVT TO CSM
CDR Verify FWD DUMP vlv - AUTO
CMP 02 PRESS IND sw - SURGE TK

Basic Date April 15, 1969
Changed June 6, 1969
107 & SUBS

Basic Date April 15, 1969
Changed June 1969

Verify CRYO 02 PRESS ind - 865-935 psia
REPRESS PKG v1v - OFF
DIRECT 02 v1v - OPEN until CAB PRESS 5.5 psia
then CLOSE until 02 FLOW <.5 lb/hr.
- OPEN adjust 02 FLOW - 0.6 lb/hr
TUNL VENT v1v - LM/CM ΔP
LM/CM ΔP ind - +4 psid (pegged)
PRESS EQUAL v1v - OPEN until LM/CM ΔP ind - ∿3 psid then CLOSE
Monitor LM/CM ΔP ind for 3 min and verify ΔP stable
PRESS EQUAL v1v - OPEN
Remove hatch and stow (DECAL) (3)
Verify docking latches (at least 3)
Transfer the following to CDR:
- Helmet Stowage bag (2)
- SRC bags (2)
- CSC bag (1)
- Hasselblad magazine bag (1)
- Closeup camera cassette bag (1)
- Vacuum brush (1) with 3 ft hose
- Glove bags (2)

Receive from LM & stow

Item		CM Stowage Location
Helmets	(2)	[redacted] UPPER EQUIP BAY
SRC's	(2)	B5, B6
CSC	(1)	A5
Hasselblad magazines	(3)	R13
Closeup camera cassette	(1)	A5

Transfer B5 & B6 containers to LM

CDR to CM with ISA
Remove & stow ISA contents
Return ISA with CM Jettison articles to LM

LMP Close LM hatch
Transfer to CSM

CMP DIRECT 02 v1v - close (CW) (DECAL)
Install forward hatch (11) (DECAL)
Perform hatch integrity check (12)

2 P00, V49, Load LM jett attitude:
F 06 22 ____,____,____
SC CONT - CMC
CMC MODE - AUTO
BMAG MODE (3) - RATE 2
PRO
PRO (Auto mnvr to jett att)
cb SECS ARM (2) - close
SECS LOGIC (2) - on (up)
Obtain GO from MSFN
SECS PYRO ARM (2) - ARM

EMS FUNC-ΔV SET/VHF RNG
EMS ΔV CTR-+100fps
EMS FUNCT-ΔV

3 At Jett Attitude:
ENTR
BMAG MODE (3) - ATT 1/RATE 2
SC CONT - SCS
Load DAP N46: 11102
V37E 47E

4 CSM/LM FINAL SEP (2) - ON (.4 fps sep)
SECS PYRO ARM (2) - SAFE
SECS LOGIC (2) - OFF
cb SECS ARM (2) - open

5 ~~Sep: P47~~
EMS MODE - NORMAL
SEP (4 jet -X 2.0 fps [redacted]
PRO (P00)

6 EMS MODE - STBY
EMS FUNCT - OFF

SUIT CKT RET VLV - CLOSED
DEMAND REGS - OFF

7 VACUUM & DOFF PGA'S
ALL SUIT FLOW vlv - ~~OFF~~ FULL FLOW
~~Disconnect RH O2 hoses from PGA~~
Install vacuum brush on RH O2 red hose
INSTALL INTERCONNECT ON L O2 RED HOSE
INSTALL SCREEN ON L O2 RED HOSE
~~RH SUIT FLOW vlv - CABIN~~
Vacuum brush PGA (2)
Empty PGA (2) pockets
Doff PGA (2)
SUIT CKT RET VLV - OPEN
DEMAND REG - BOTH
Move watch (2) from PGA to arm
Stow PGA (2)

8 All wash hands thoroughly

Basic Date April 15, 1969
Changed June 7, 1969

SECTION 13. LOI ABORT

LOI 15 MIN SPS

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

RECORD DATA AND COMPUTE PAD

F 97 40
Record TFC _____
Vg _____
ΔVm _____
EMS Vc _____
ENTR
F 99 40
Maneuver to LOI1 Attitude
ENTR
F 16 85
Record Vx _____
Vy _____
Vz _____
PRO
F37 V82E

PRIMARY
G&N ΔVm _____
VcABORT(Chart)_____
GET LOI1 _____
+15:00
GET TEI ABORT__:__:__

ALTERNATE
ΔVcLOI1 PAD _____
EMS Vc(Shutdown)_____
Vc(Burned)_____
Vc ABORT(Chart)__

F 16 44
Record Ha _____
Hp _____
TFF _____
PRO
F 37 00E
When CMC ACTY lt out:
V66E

Basic Date APRIL 15, 1969
Changed ___J___27, 1969

CSM 107 & SUBS

MAN ATT PITCH - ACCEL CMD 178.8,62.4,4.5
SET in GDC THUMBWHEELS - (~~178.8,68.0,0.2~~)
MAN MNVR To ABORT R,P,Y
GDC ALIGN
CHECK DAP (P&Y TRIM)
EMS FUNC - ΔV SET/VHF RNG
SET ΔVc ABORT
EMS FUNCT - ΔV

TVC CHECK & PREP
cb STAB CONT SYS (all) - close
cb SPS (12) - close
RATE - LOW (verify)
LIMIT CYCLE - ON
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/RATE2
ROT CONTR PWR DIR(2) - OFF
SCS TVC (2) - AUTO
TVC GMBL DRIVE P&Y - AUTO
MN BUS TIE (2) - ON (verify)
TVC SERVO PWR #1 - AC1/MNA
TVC SERVO PWR #2 - AC2/MNB
TRANS CONTR PWR - ON
ROT CONTR PWR NORMAL #2 - AC
RHC #2 - ARMED

-5m

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

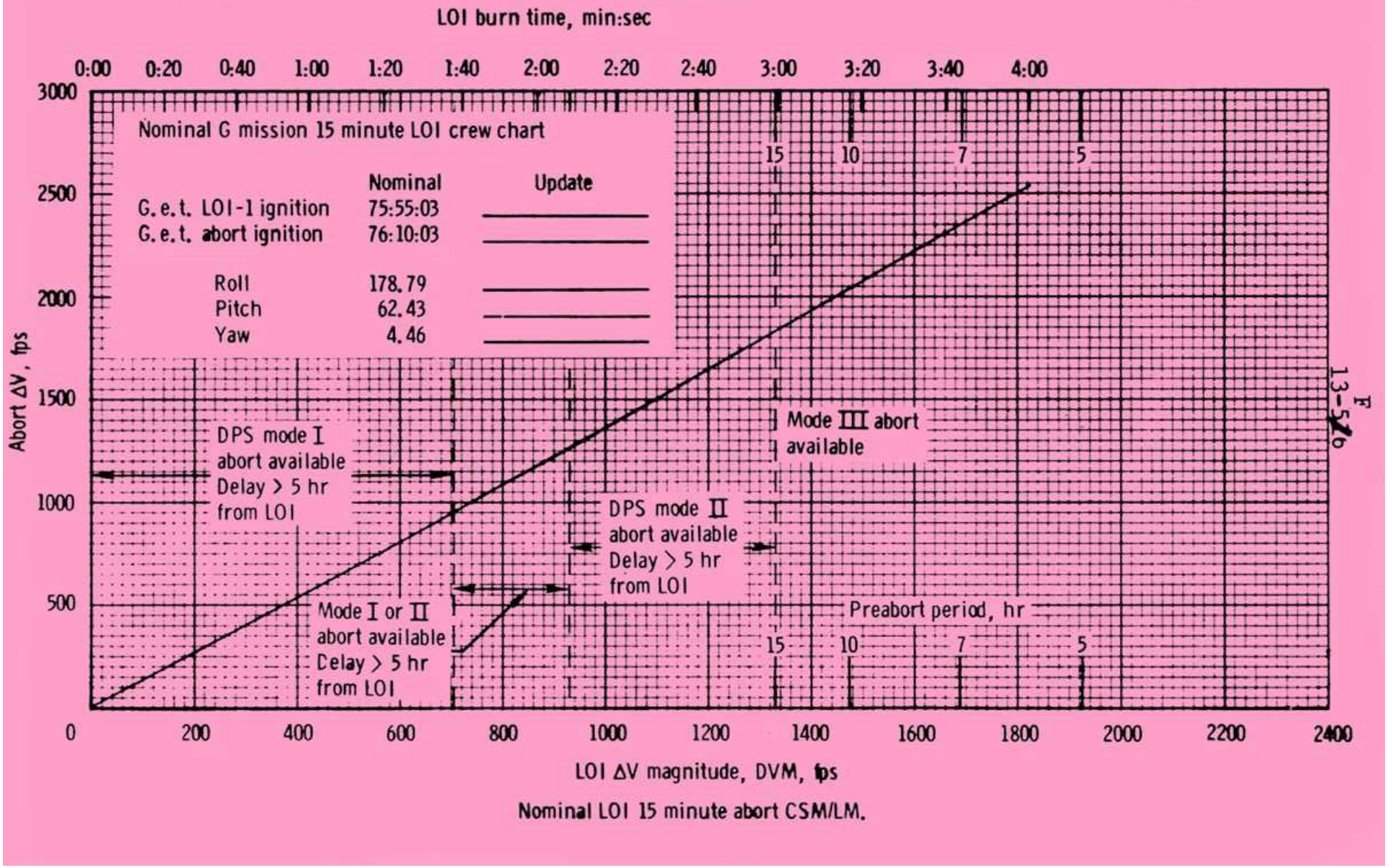
SEC TVC CHECK
GMBL MOT P2-Y2 - START/ON (LMP Verify)
SET GPI TRIM
Verify MTVC
THC - NEUTRAL
Verify GPI Returns To Trim Pos
ROT CONT PWR NORM (2) - AC/DC
ATT DB - MIN (verify)
ROT CONTR PWR DIR (2) - MNA/B
SPS HE vlvs (2) - AUTO, verify tb-bp
LIMIT CYCLE - OFF

Basic Date AP 15, 1969
Changed JUNE 16, 1969
CSM 7 & SUBS

	FDAI SCALE - 50/15 (verify)
-2m	EMS MODE - NORMAL
	V37E 47E
	ΔV THRUST A(B) - NORMAL
	THC - ARMED (verify)
	RHC #1&#2 - ARMED
	PCM BIT RATE - HIGH
-10s	ULLAGE
00	THRUST ON pb - push
	SPS THRUST lt - on
	MONITOR THRUSTING
	Pc 95-105 psia
	EMS COUNTING DOWN
	SPS INJ vlvs (4) - OPEN
	SPS HE vlvs tb (2) - gray
	SPS FUEL/OXID PRESS - 175 to 195 psi
	ECO
	ΔV THRUST (2) - OFF
	SPS INJ vlvs (4) - CLOSED
	SPS He tb (2) - bp
	GMBL MOTS (4) - OFF (LMP Verify)
	TVC SERVO PWR (2) - OFF
	MN BUS TIE (2) - OFF
	PCM BIT RATE - LOW
	BMAG MODE (3) - RATE 2
	F 16 83
	RECORD Vx_____
	Vy_____
	VZ_____
	PRO
	F37 00E
	V66E
	EMS ΔVc _____
	EMS MODE - STBY
	EMS FUNCT - OFF

CSM 107 & SUBS Basic Date APRIL 15, 1969
Changed JUNE , 1969

Basic Date June 13, 1969
Changed J 27, 1969



F 13-51b

Nominal LOI 15 minute abort CSM/LM.

SECTION 14. FLIGHT EMERGENCY PROCEDURES

FIRE/SMOKE IN CM (CREW SUITED)

WARNING: CM water must not be used to extinguish fire

1 CAB FAN (2) - OFF (verify)

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

3 Verify suit compressor on good AC bus

4 Use fire extinguisher as appropriate

FIRE IS OUT

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

FIRE PERSISTS - DUMP CABIN

6 Verify:
SUIT CKT RET vlv - CLOSE (push)

EMER CAB PRESS vlv - OFF

REPRESS PKG vlv - OFF

7 Visually check suit integrity

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

9 Verify Suit pressure >3.5 psia

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

Basic Date April 15, 1969
Changed June 1, 1969
CSM 107 & SUBS

11 CAB PRESS ind 0.0 psia for 6 min

12 CAB PRESS REL (RH) - NORMAL

13 CAB PRESS DUMP v1v - CLOSE

14 Do not repress cabin until fire source is removed

FIRE/SMOKE IN CM (CREW UNSUITED)

WARNING: CM water must not be used to extinguish fire

1 CAB FAN (2) - OFF (verify)

2 SUIT COMPR (2) - OFF

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

4 Don emergency O2 masks

5 Use fire extinguishers as appropriate

FIRE IS OUT

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

FIRE PERSISTS - DON SUITS and DUMP CABIN

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

8 DIRECT O2 v1v - OPEN
Purges suit circuit of smoke and fumes

9 Don helmet

10 SUIT FLOW v1v (3) - SUIT FULL FLOW

Basic Date April 15, 1969
Changed June 1, 1969

M 107 & SUBS

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

12 DIRECT O2 v1v - CLOSE

13 EMER CAB PRESS v1v - OFF

14 Visually check suit integrity

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

16 Verify Suit pressure holding >3.5 psia

17 CAB PRESS REL (RH) - DUMP
and/or CAB PRESS DUMP v1v - OPEN

18 CAB PRESS ind 0.0 psia for 6 min.

19 CAB PRESS REL (RH) - NORMAL

20 CAB PRESS DUMP v1v - CLOSE

21 Do not repress cabin until fire source is removed

Contamination in CM

1 Don O2 masks and/or PGA's immediately

2. Evaluate contamination level (isolate & correct source of contamination if possible) and proceed with one of the following steps:
   a. Retain O2 masks or remain in suit and accept contamination level in cabin.

CAUTION

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

CSM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

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

CAUTION
Change LiOH cartridges after scrub completed.

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

Contamination In Suit

1 SUIT COMPR 2 - AC1

2 SUIT COMPR 1 - OFF

3 DIRECT O2 vlv - OPEN for 1 minute then CLOSE

If condition persists:

4 SUIT COMPR 2 - OFF

5 DIRECT O2 vlv - CLOSE

6 Doff helmet

7 Don emergency O2 masks

C&W/MALFUNCTION INDICATORS

CMC

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

1

Basic Date April 15, 1969
Changed June 1, 1969
CM 107 & SUBS

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

CSM 107 & SUBS Basic Date April 15, 1969 Changed July 5, 1969 REV I

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

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

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

AC BUS + AC BUS OVERLOAD + MAIN BUS UNDERVOLT

Replace INV — SSR-2
If still OVERLOAD - Disconnect 2nd INV

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

Basic Date April 15, 1969
Changed July 5, 1969 REV I
CSM 107 & SUBS

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

Basic Date April 15, 1969
Changed June 1, 1969
CSM 107 & SUBS

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

SPS BURN	AMPS
O2 HTRS (2) - off (ctr)	11.05
BAT C on MNA&B	
cb MNA BAT C - close	
cb MNB BAT C - close	
ECS RAD HTRS (2) - OFF	17.2 per HTR
If unsuited	
SUIT COMPR (2) - OFF	8.44
S BD PWR AMP - off (ctr)	4.35
FC PUMPS (3) - OFF	9.43
SM RCS HTRS (4) - OFF	2.90 per quad MAX
POT H2O HTR - OFF	1.62
H2 HTRS (2) - off (ctr)	1.43
H2 FANS (2) - off (ctr)	0.72
O2 FANS (2) - off (ctr)	5.4
SPS LINE HTRS - off (ctr)	1.025 A 2.05 A/B
LIGHTS (min req'd)	
TAPE RCDR FWD - off (ctr)	1.69
SPS GAUGING - OFF	2.96
ECS GLY PUMPS (2) - OFF	2.76 per pump
cb ECS RAD CONT/HTR (2) - open	2.69
SCE PWR - off (ctr)	0.65

TELECOM GRP 1&2 - OFF 3.71
cb INSTR ESS (2) - open 4.80

BUS LOSS RECONFIGURATION

A Loss of MN BUS A
FC 2 - MNB only
FC 1 - MNB (if req'd)
INV 3 - MNB, AC1
cb MNA BAT BUS A - open
cb MNB BAT C - closed
SUIT H2O ACCUM AUTO - 2
BMAG MODE (3) - RATE 2
FDAI SEL - 2
URINE DUMP - HTR B
WASTE H2O DUMP - HTR B
RHC PWR DIR 2 - MNB
AUTO RCS SEL (16) - MNB
RAD PRIM HTR - 1
SPS LINE HTR - A/B (as req'd)
RAD FLOW CONT PWR - MAN SEL
SCS TVC (P&Y) - RATE CMD

B Loss of MN BUS B
FC 2 - MNA only
FC 3 - MNA (if req'd)
INV 3 - MNA, AC2
cb MNB BAT BUS B - open
cb MNA BAT C - closed
BMAG MODE (3) - RATE 1
RHC PWR DIR 1 - MNA
AUTO RCS SEL (16) - MNA
SCS ELEC PWR - ECA
RAD PRIM HTR - 2
RAD FLOW CONT AUTO - 1

C Loss of BAT BUS A
RAD PRIM HTR - 2
If MN BUS TIE A/C is closed
cb MNA BAT BUS A - open
cb MNA BAT C - open
If MN BUS TIE A/C is open
cb MNB BAT BUS B - open

CSM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

cb MNA BAT C - open
MN BUS TIE BAT B/C - on (up)

D Loss of BAT BUS B
RAD PRIM HTR - 1
If MN BUS TIE B/C is closed
cb MNB BAT BUS B - open
cb MNB BAT C - open
If MN BUS TIE B/C is open
cb MNA BAT BUS A - open
cb MNB BAT C - open
MN BUS TIE BAT A/C - on (up)

E Loss of AC BUS 1
AC INV 1 MNA - OFF
SUIT COMPR 2 - AC2
FDAI SEL - 2
BMAG MODE (3) - RATE 2
TELECOM GRP 1 - AC2
FC PUMP 1 - AC2
ECS GLY PUMP 2 - AC2
BMAG 1 PWR - OFF
G/N PWR - AC2
SIG CONT/BIAS PWR 1 - AC2
Maintain GLY EVAP TEMP INLET temp above 40°F
ECS RAD FLOW CONT - 2
BAT CHGR - AC2

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

PRE/POST SPS BURN

A. Loss of MN BUS A
   Pre SPS Burn
     Verify reconfiguration per mission phase
     Perform G&N SPS maneuver with
     following deviations:
       cb MNB BAT C - close
       TVC GMBL DR (P&Y) - 2
       cb SPS P1&2, Y1&2 (4) - open
         (after GMBL MTR turn on)
       SCS TVC (P&Y) - RATE CMD
   Post SPS Burn
     cb SPS P1&2, Y1&2 - close
       (prior to GMBL MTR turn on)

B. Loss of MN BUS B
   Pre SPS Burn
     Verify reconfiguration per mission phase
     Perform G&N SPS maneuver with
     following deviations:
       cb MNA BAT C - close
       TVC GMBL DR (P&Y) - 1
       cb SPS P1&2, Y1&2 - open
         (after GMBL MTR turn on)
   Post SPS Burn
     cb SPS P1&2, Y1&2 - closed
       (prior to GMBL MTR turn off)

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

           NOTE
     If BUS TIE B/C is already closed,
     BAT C should be brought on line
     when ready to tie bats to mains.

     TVC GMBL DR (P&Y) - 2
     After GMBL start,
       cb SPS P1&2, Y1&2 - open

Basic Date April 15, 1969
Changed June 1, 1969
CSM 107 & SUBS

Post SPS burn
cb SPS P1&2, Y1&2 - closed
(prior to GMBL MTR turn off)

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

NOTE
If BUS TIE A/C is already closed, BAT C should be brought on line when ready to tie bats to mains.

TVC GMBL DR (P&Y) - 1
After GMBL start,
cb SPS P1&2, Y1&2 - open

Post SPS Burn
cb SPS P1&2, Y1&2 - closed
(prior to GMBL MTR turn off)

E. Loss of AC BUS 1
AC INV 1 MNA - OFF
S BD NORM PWR AMP - SEC
S BD NORM XPNDR - SEC
FC PUMP 1 - AC2
G/N PWR - AC2
ECS GLY PUMP 2 - AC2
BMAG 1 PWR - OFF
SIG COND/BIAS PWR 1 - AC2
FDAI SEL - 2
SCS TVC (2) - RATE CMD
BMAG MODE (3) - RATE 2
TVC SERVO PWR 1 - AC2/MNB
SPS GAUGING - AC2

F. Loss of AC BUS 2
AC INV 2 MNB - OFF
S BD NORM XPNDR - PRI

CSM 107 & SUBS
Basic Date ___April 15, 1969
Changed ___June 1, 1969

Note: If post TLI, TELECOM GRP 2 - AC1
FC PUMP 2&3 - AC1
BMAG 2 PWR - OFF
FDAI SEL - 1
SCS ELEC PWR - ECA
SCS TVC (P&Y) - RATE CMD
BMAG MODE (3) - RATE 1
TVC SERVO PWR 2 - AC1/MNA

DURING CRITICAL SPS BURNS

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

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

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

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

Loss of BAT BUS A
cb MNA BAT C - closed

CSM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

Loss of BAT BUS B
cb MNB BAT C - closed

LOSS OF TWO FUEL CELLS

1. Power down the following:

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

Panel 3
SPS LINE HTR - off (ctr)
TAPE RCDR FWD - off (ctr)
S BD NORM PWR AMP - off (ctr)
Select single inverter operation
Configure remaining fuel cell to both main busses

Panel 5
cb ECS RAD HTR OVLD (2) - open
Failed FC PUMPS (2) - OFF

Panel 7
SCS LOGIC PWR 2/3 - OFF
BMAG PWR (2) - OFF (place to WARMUP
40 min prior to an IMU/GDC align)
FDAI/GPI - OFF

Panel 8
AUTO RCS SEL (16) - OFF
cb SCS LOGIC (4) - open

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

CSM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

b. After IMU align OPT PWR - OFF

c. If main bus voltage 26.0 vdc with CMC, IMU, and OPTICS up perform the following:

1) If sufficient battery energy is available, place battery with highest energy on both main busses.

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

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

   Arm logic
   Arm pyros
   Press CM RCS
   Safe pyros
   Safe logic

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

NON-DIODED/NON-SWITCHABLE LOADS

MAIN A
- O2 & H2 TK 1 HTRS
- PP CO2 (TLM & Onboard)
- PRIM 2 RAD HTR

CSM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

RAD SEC HTR
RAD MAN SEL
RAD FLOW CONT No. 1 & AUTO SEL capability
RAD SEC TEMP Inlet & Outlet (SFO262T & SFO263T)
AUTO & semi-auto operation of No. 1 H2O ACCUM
sw if H2O ACCUM (Pnl 382) is in the RMTE position
INV 1
16mm SEQ Camera
Quads B, D; CM1, HTRS & Isol vlvs
ΔV THRUST A
PRI GMBL MTRS P,Y
L COAS
Flashing RNDZ Lts
FDAI 1
GDC
BMAG 1 (immediately)
RHC PWR DIR 1 (HALF THE JETS)
DIRECT ULLAGE PB (C3 &A4)

MAIN B

O2 & H2 TK HTRS
PRIM 1 RAD HTR
PRIM RAD INLET TEMP
RAD FLOW CONT No. 2
H2O ACCUM 2
INV 2
Quads A,C; CM2, HTRS & Isol vlvs
ΔV THRUST B
SEC GMBL MTRS P,Y
FDAI 2
GDC (All modes)
BMAG 2
RHC PWR DIR 2 (HALF THE JETS)
DIRECT ULLAGE PB (D3 & B4)
ORDEAL

BAT BUS A

SECS & ELS System A
UPRIGHTING SYS COMPR 1
UPRIGHTING FLOAT BAG 1
EDS Voting Logic 1
GMBL MTR Control (On-Off) P1 & Y1
MN BUS TIE A/C

CSM 107 & SUBS
Basic Date April 15, 1969
Changed June 1, 1969

BAT BUS B
- SECS & ELS System B
- UPRIGHTING SYS COMPR 2
- UPRIGHTING FLOAT BAG 2
- EDS Voting Logic 3
- GMBL MTR Control (On-Off) P2 & Y2
- MN BUS TIE B/C

AC BUS 1
- 02 & H2 TK 1 FAN, Qty & Temp
- CAB FAN 1
- RAD FLOW CONT No. 1
- Man control of GLY EVAP STM PRESS (ϕC) (Pri Sys)
- Elect control of SUIT HT EXCH PRI GLY CONT v1v (ϕB)
- Auto control of PRI GLY EVAP TEMP IN v1v (ϕA)
- EMS ΔV
- FDAI 1
- GPI (primary)
- GDC
- SCS MIN IMP & RATE CMD
- BMAG 1
- RHC 1 for MTVC (ϕA only)

AC BUS 2
- 02 & H2 TK 2 FAN, Qty & Temp
- PRI EVAP TEMP Cont Unit (ϕA)
- CABIN TEMP AUTO Control unit (ϕC)
- CAB FAN 2
- FDAI 2
- RSI
- BMAG 2
- GDC
- RATE CMD
- MTVC
- GPI (secondary)
- ORDEAL

CSM 107 & SUBS
Basic Date—April 15, 1969
Changed—June 1, 1969