

APOLLO 10

ALTERNATE & CONTINGENCY
CHECKLIST

PART NO.

S/N

SKB32100079-304

1002

Loss of Comm Navigation Procedures

1. TL+4 Hours abort

- a. Make abort burn
- b. Re-initialize W-matrix
- c. Initiate sighting as soon as possible after abort following the schedule given in the crew chart.

(1.) The horizontal lines represent the start of the sighting intervals.

(2.) The vertical lines represent stars which are available for use with P23.

(3.) The numbers adjacent to the vertical lines are the required sightings with the given star.

(4.) Only earth horizon marks will be made.

d. Two charts are provided for each launch day; one is for a short return time using the 72.1 injection (approximately 19 hours or less), the second for longer returns using the 108.2 injection (19 hours or greater). Targets for aborts from other injection opportunities are nearly identical to these schedules with variations in star AOS and LOS.

2. LO aborts (detailed schedules provided)

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

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

c. Change to EI chart at EI-40

d. The key for the detailed schedule is:

Vertical Solid Line: Star/Horizon combination available for earliest TLI (72°, 1st opportunity).

Vertical Dashed Line: Star/Horizon combination available for latest TLI (108°, 2nd opportunity).

Horizontal Solid Line: Sighting interval.

N: N sets of 3 marks on this star/horizon or star/landmark combination.

3. General TE optical navigation rules

- a. A sighting is to consist of three marks.

b. A sighting interval is to consist of at least three star/horizon sightings; although as many as five are advisable (five should be used at the end of every sleep period). Observations using stars in the orbit plane should be emphasized. One sighting using an out-of-plane star (angle ≥ 45 degrees to the orbit plane) in every five sets is sufficient. If only three stars are grouped together, all stars should be in plane.

c. The navigation intervals should be scheduled so that, immediately following a period of length Δt , not to exceed 3 hours in a non-PTC mode, five times Δt should be spent in a PTC mode (thermal constraints), provided it does not interfere with navigation sightings which are essential for a safe entry.

d. The sextant calibration routine will be exercised at least every half hour while navigation sightings are in progress. The sextant calibration will be repeated until agreement of at least two checks (not necessary sequential ones) are within 0.003 degrees.

e. If an abort burn is performed during translunar coast, the W-matrix will be reinitialized to its launch value of 3,300 feet and 3.3 feet per second for onboard processing of the transearth sighting data. Navigation sightings intervals will be scheduled every 2.5 hours, and only star/earth horizon sightings should be made. The last sighting will be scheduled just after the last midcourse correction at EI-3 hours.

f. The transearth navigation sighting schedule in the flight plan is designed for a 54-hour return trajectory. In the event that the return time is altered (i.e., early TLI because of a communication loss, ect.) the following rules are to be followed for setting up a navigation schedule which will ensure a safe entry:

(1.) TEI through TEI+17

The nominal schedule is to be adhered to from TEI to TEI+17. The first two batches of sightings are to be on the moon, and the second two batches are to be on the earth. They are scheduled at TEI+1:30,

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TEI+12:30, TEI+13:30, and TEI+16:00 hours. The corresponding sightings are shown in the flight plan.

(2.) EI-17 through EI

The nominal schedule is also to be adhered to from EI-17 to EI. The navigation sightings are scheduled at EI-16, EI-11:20, EI-10:20, EI-7:40, EI-5, and EI-2:20. The corresponding central body for the star/horizon sightings is shown in the flight plan.

(3.) TEI+17 through EI-17

Between TEI+17 and EI-17 schedule two-thirds as many sightings as there are hours of coast during this period. Sightings should be scheduled in a ration of 2 to 1, earth to moon, with a minimum of 17 sightings during this coast period (i.e., if the time between TEI+17 and EI-17 is less than 25.5 hours, 17 sightings during this coast period (i.e., if the time between TEI+17 and EI-17 is less than 25.5 hours, 17 sightings will be required).

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P37 RETURN TO EARTH PGM - CORRIDOR CONTROL

Perform the following once:

If TLI+10 min Abort performed

V21 N1E

3376E

OE

If no TLI+10 min Abort

V1N1E

3376E

Verify R1=01652

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

2 F 06 60 BLANK,V DESIRED,GAMMA EI (1fps,.01°)
Load desired values
FOR MIN ΔV-LOAD +00000 IN R2 (Use pad values on TLC)
For middle of corridor-load +00000 in R3
PRO

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

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

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

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

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CSM

6 F 06 81 ΔVXYZ(LV) TIG (.1fps)
(OPTION) N40E - ΔV 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 *

7 F 04 06 THRUST OPTION
R1 00007
R2 0000X
X=1(SPS)
2(RCS)
If RCS - perform R03
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)

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

Perform the following once:

If TLI+10 min Abort performed

V21 N1E

3376E

OE

If no TLI+10 min Abort

V1N1E

3376E

Verify R1=01652

```

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: (1fps,.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 *
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3 F 06 61 IMPACT LAT, IMPACT LONG (.01°)
If Impact LONG < 12° from desired:

PRO → Record Impact LONG as θ_{c1}
If Impact LONG > 12° from desired:

TEC: N40E Record R2 as ΔV_{min} fps	TLC V32E to 1
V32E to 1 & use $ \Delta V > \Delta V_{min}$	Decrease ΔV to
ΔV neg to move LONG WEST	move LONG WEST
ΔV pos to move LONG EAST	Increase ΔV to
	move LONG EAST

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

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

6 F 06 81 $\Delta VXYZ(LV)$ at TIG
N40E
Record R2 as ΔV_{c1}
KEY RLSE
PRO

*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 $\theta_{p1} = \underline{\hspace{2cm}}$
If θ_{p1} , acceptable, PRO to step 4 of
CORRIDOR CONTROL (pg. G/1-38)

PRO

8 F 06 39 ΔT TRANSFER
PRO

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

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10 F 06 81 $\Delta VXYZ(LV)$ at TIG
N40E
R2 XXXX.X Record as $\Delta V_{p1} = \underline{\hspace{1cm}}$ fps
V32E to 11

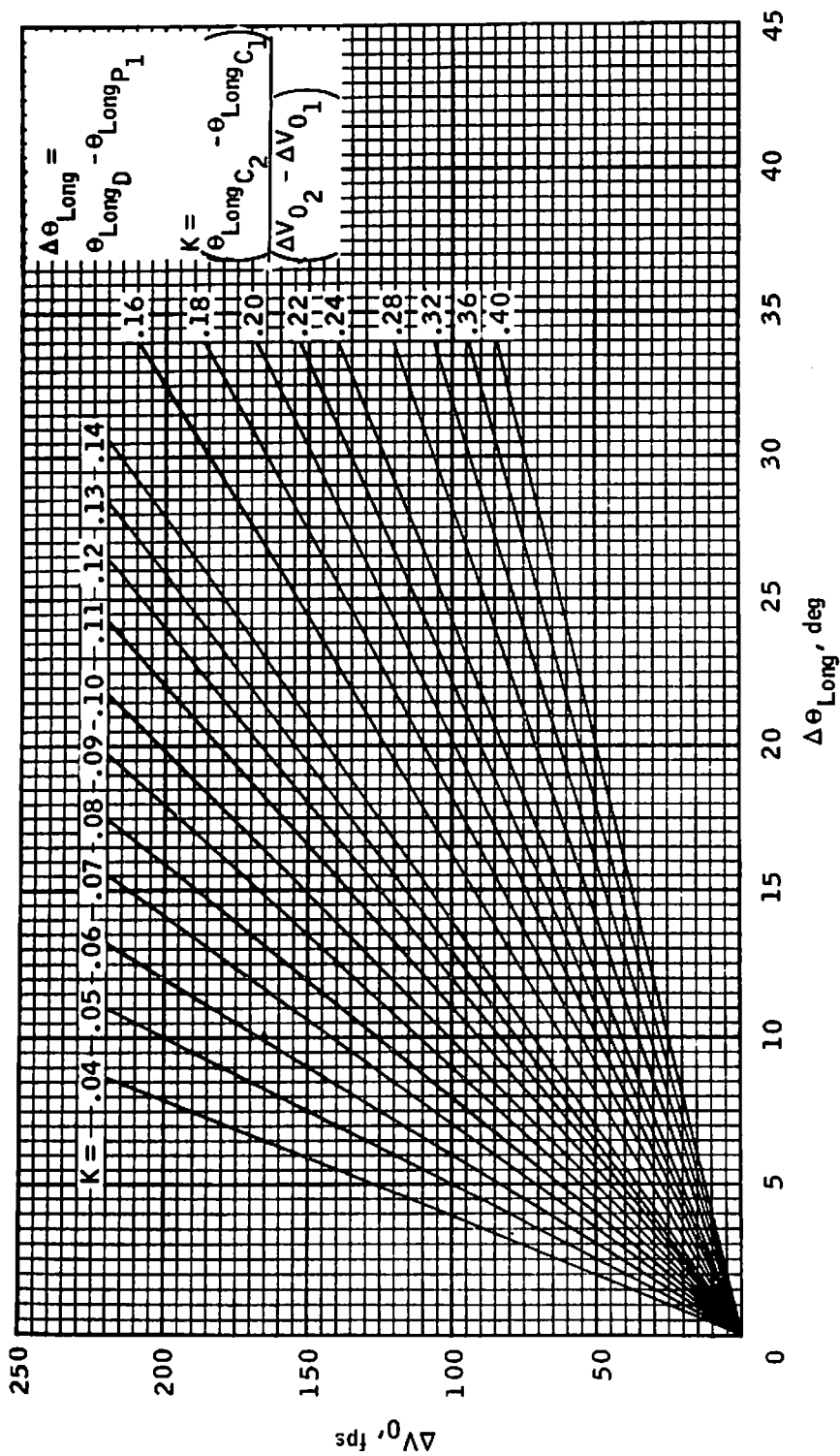
11 F 06 33 TIG (hrs,min,.01sec)
Load same value used initially
PRO

12 F 06 60 BLANK, ΔV DESIRED, GAMMA EI DESIRED
To move West from θ_{p1}
TEC: Load $\Delta V_{c2} = -\Delta V_{c1} - 10$
TLC: Load $\Delta V_{c2} = \Delta V_{c1} - 10$
To move EAST from θ_{p1}
TLC or TEC: Load $\Delta V_{c2} = \Delta V_{c1} + 10$
Record $\Delta V_{c2} = \underline{\hspace{1cm}}$ fps
R2 XXXXX.
PRO
F 05 09 SAME AS-IN 2
*V32E. RSET to 11 *

13 F 06 61 IMPACT LAT, IMPACT LONG θ (.01°)
Record LONG as $\theta_{c2} = \underline{\hspace{1cm}}$
Compute $K = \frac{|\theta_{c2} - \theta_{c1}|}{10} + \underline{\hspace{1cm}}$
Compute $\Delta \theta_{Long} = \theta_d - \theta_{p1} = \pm \underline{\hspace{1cm}}$
Obtain from Chart $\Delta V_{\theta} = \pm \underline{\hspace{1cm}}$
Make sign of ΔV_{θ} same as $\Delta \theta_{Long}$
If ΔV_{c2} pos, $\Delta V_d = \Delta V_{p1}(\text{step } 10) + \Delta V_{\theta}$
If ΔV_{c2} neg, $\Delta V_d = -\Delta V_{p1} + \Delta V_{\theta}$
 $\Delta V_d = \underline{\hspace{1cm}}$

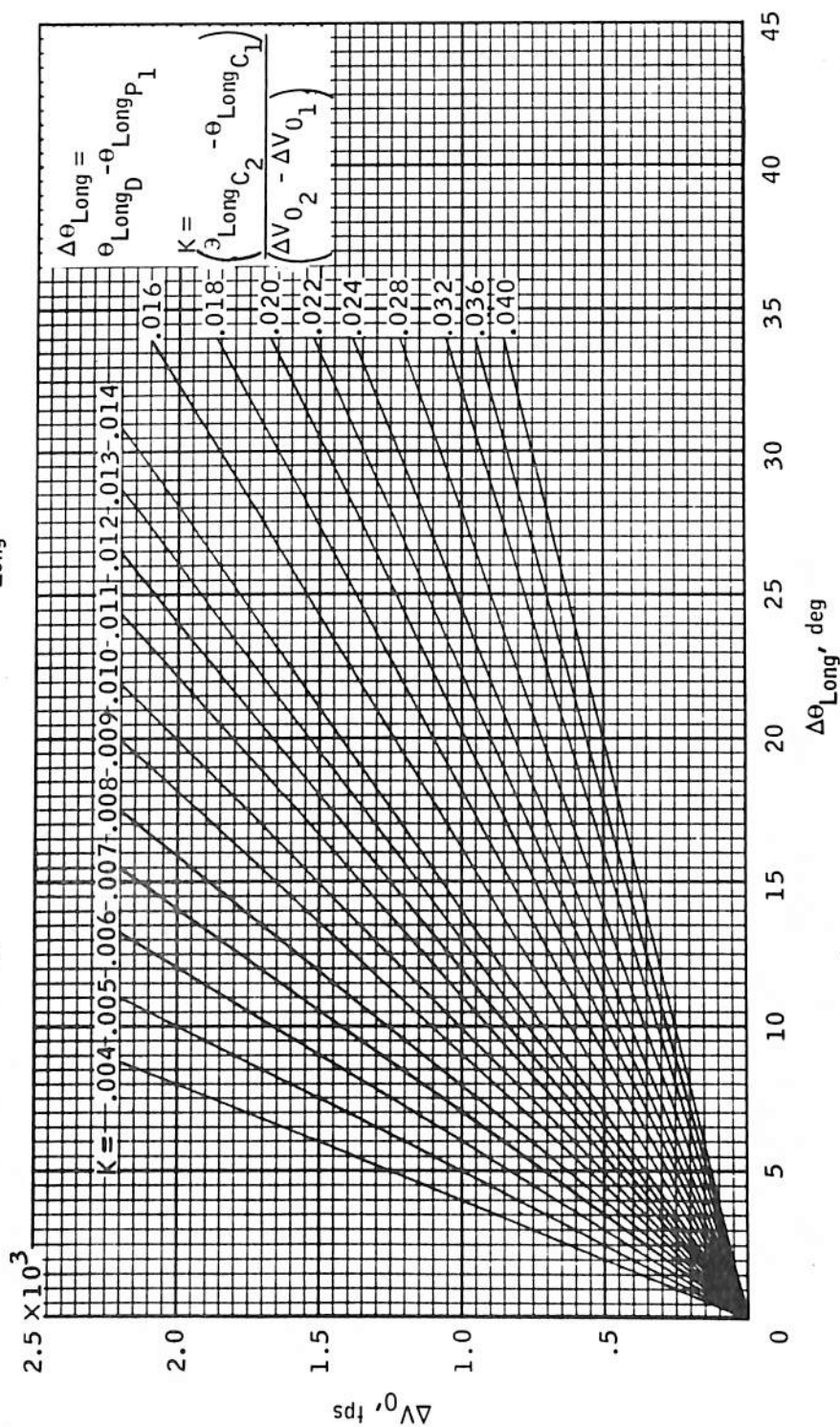
14 V32E to step 1 of Corridor Cont G/1-38
& use ΔV_d in R2 of N60

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Increase in ΔV_0 to produce a desired increase in θ_{Long} : $K = .4$ to $.04$.

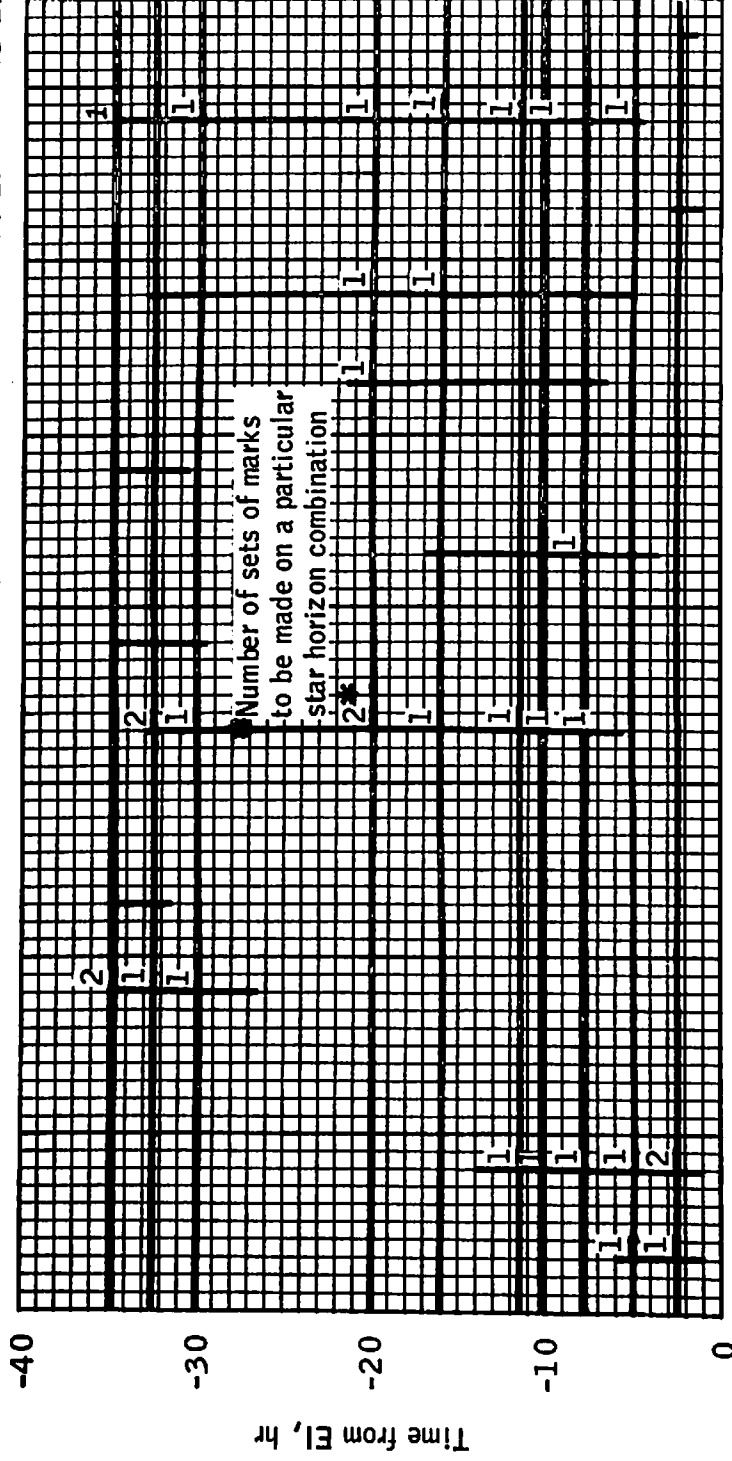
Increase in ΔV_0 to produce a desired increase in θ_{Long} : $K = .04$ to $.004$.



Star number (octal)
Central body - horizon

F = Far, N = Near

2 EN 33 EF 34 EF 37 EF 40 EN 40 EF 42 EN 44 EN 44 EF 45 EN 45 EF



152/128 -153/-130 2/1 124/105 -112/-93 150/107 -156/-106 19/3 64/60 -76/-54 89/42 -66/-48

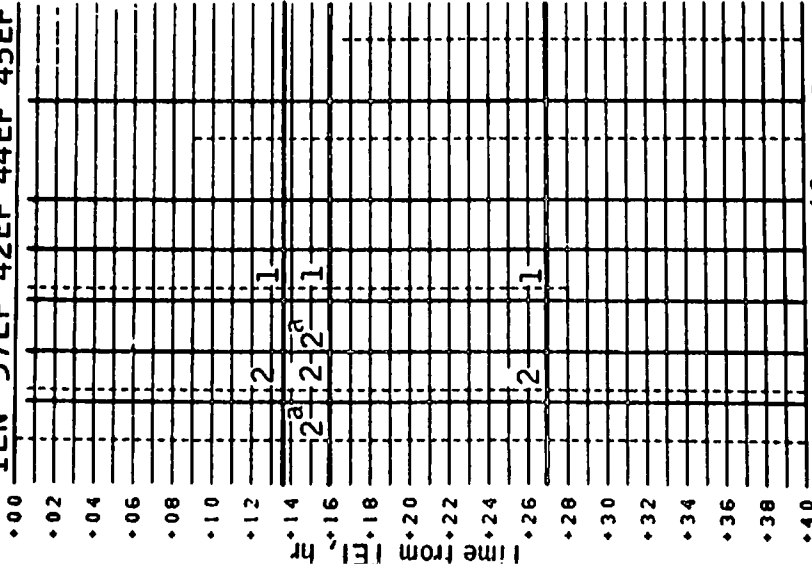
Measured plane angle, deg (AOS/LOS)

Star number (octal)

Central body - horizon

2EN 30EF 44EN 45EN

1EN 37EF 42EF 44EF 45EF



26	66	63	51
52	43	89	70
36	5	59	80
69	9	56	40
			79
			31

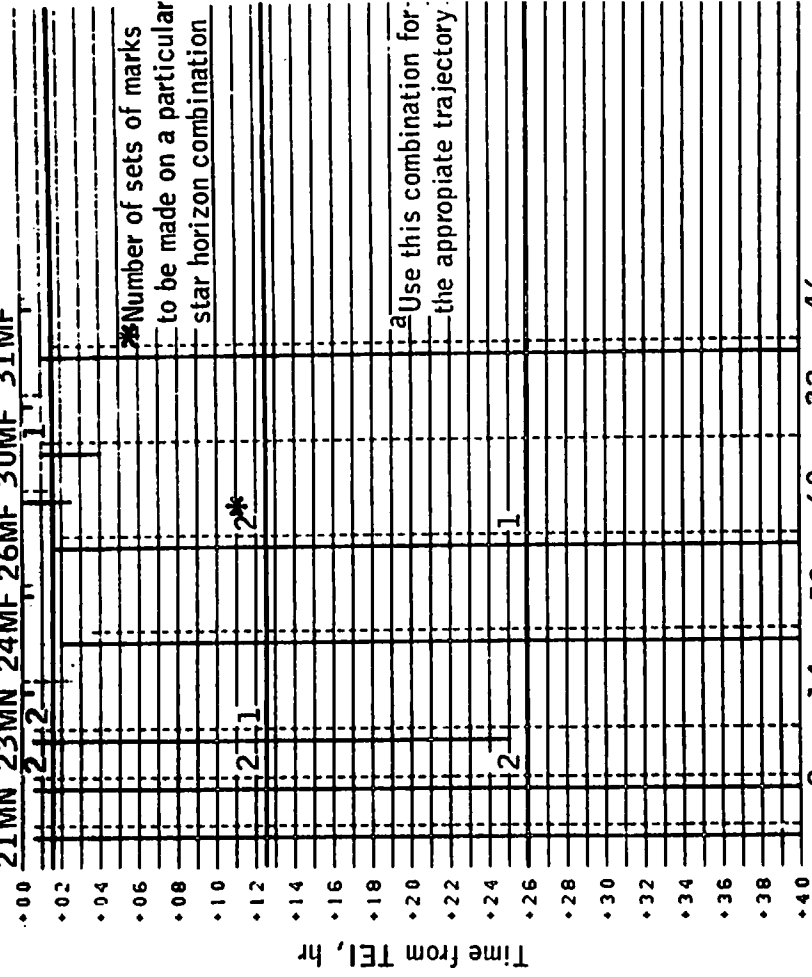
Measured plane angle, deg (AOS/LOS)

Star number (octal)

Central body - horizon

22MN 24MN 25MN 27MN 31MN 32MN

21MN 23MN 24MF 26MF 30MF 31MF



2	14	53	60	32	46
10	29	87	85	73	82
22	19	76	6	45	79
44	89	42	14	31	38

Measured plane angle, deg (AOS/LOS)

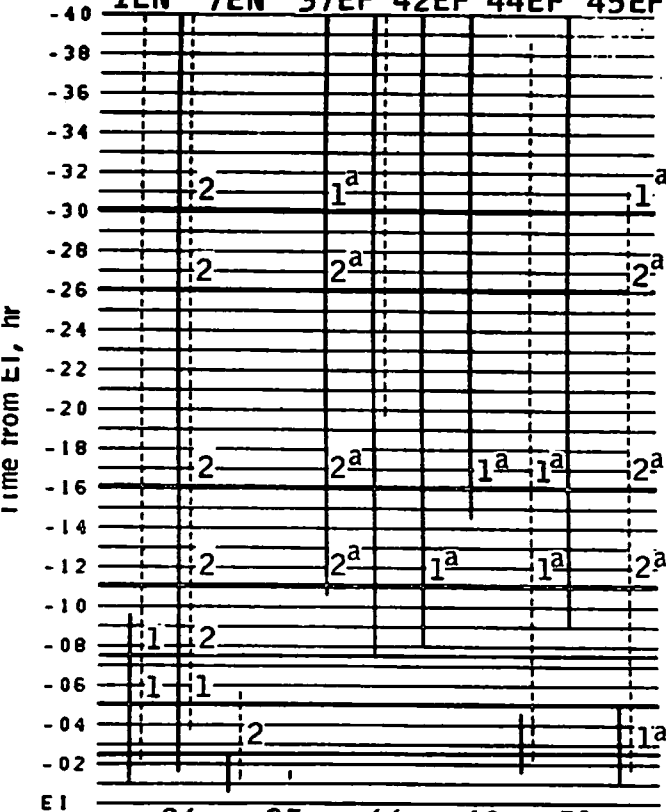
*Number of sets of marks to be made on a particular star horizon combination

^aUse this combination for the appropriate trajectory

Star number (octal)

Central body - horizon

2EN 10EN 40EF 44EN 45EN
1EN 7EN 37EF 42EF 44EF 45EF

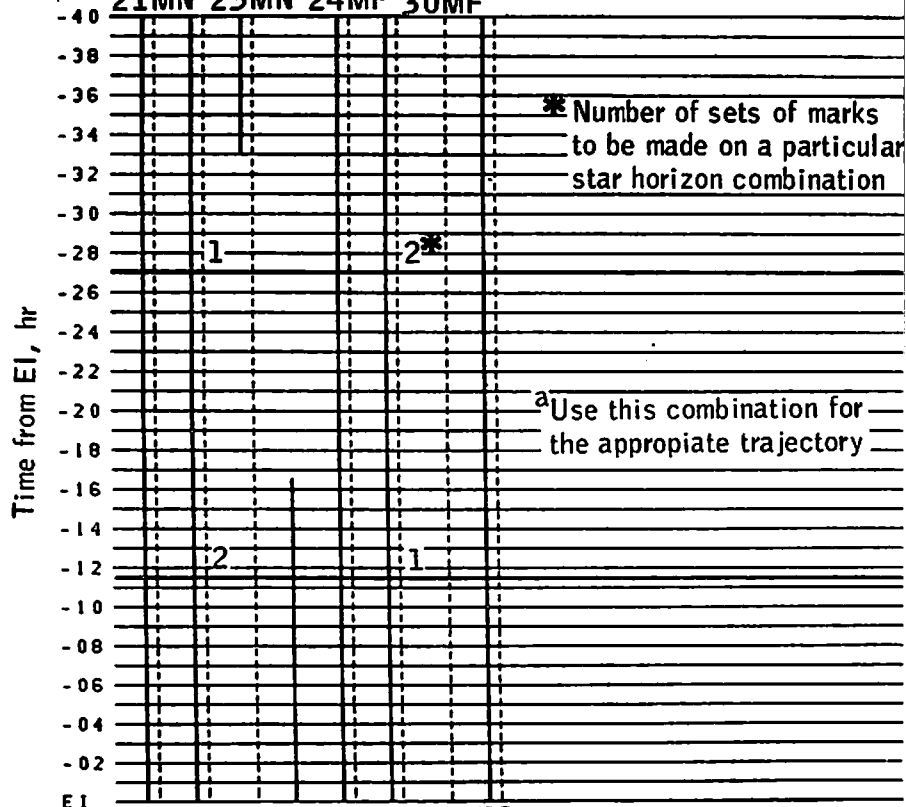


Measured plane angle, deg (AOS/LOS)

Star number (octal)

Central body - horizon

22MN 23MF 26MF 31MF
21MN 23MN 24MF 30MF



Measured plane angle, deg (AOS/LOS)

* Number of sets of marks
to be made on a particular
star horizon combination

^a Use this combination for
the appropriate trajectory

G&N HYBRID DEORBIT

VEHICLE PREP COMPLETE

P30 - EXTERNAL ΔV
V37E 30E

1

2 F 06 33 GETI (hr,min,.01sec)
(ACCEPT) PRO
(REJECT) LOAD DESIRED GETI

3 F 06 81 ΔVX,Y,Z (LV) (.1fps)
(ACCEPT) PRO
(REJECT) LOAD DESIRED GETI

4 F 06 42 HA,HP,ΔV (.1nm,.1fps)
Record ΔV _____
(ACCEPT) PRO
(REJECT) Reselect P30 or P27. Load new param.

5 F 16 45 M,TFI,MGA (marks,min-sec,.01°)
*MGA -00002: if *
* IMU not aligned*

SET DET
PRO

6 F 37 00E

7 SEPARATION CK LIST

PRIM GLY TO RAD - BYPASS (Pull)
PLSS 02 vlv - FILL
02 SM SUPPLY vlv - OFF
CAB PRESS REL vlv (2) - NORM
cb ELS (2) - close (verify)
cb SECS ARM (2) - close (verify)
cb SECS LOGIC (2) - close (verify)
ROT CONTR PWR NORM 1&2 - AC/DC
ABORT SYS PRPLNT - RCS CMD
SM RCS SEC PRPLNT (4) - OPEN
VHF AM (A&B) - OFF

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8

CM RCS CHECK

AUTO RCS A/C ROLL (4) - OFF (verify)
cb RCS LOGIC (2) - closed (verify)
SC CONT - SCS
RCS TRANSFER - CM
AUTO RCS SEL (RING 1) - OFF
AUTO RCS SEL (RING 2) - MNB
TEST RING 2 THRUSTERS
AUTO RCS SEL (RING 2) - OFF
AUTO RCS SEL (RING 1) - MNA
TEST RING 1 THRUSTERS
RCS TRANSFER - SM *AUTO RCS SEL (RING 2) - MNB*

9

MNVR TO PAD BURN ATT

LOAD DAP
BMAG MODE (3) - RATE 2
SC CONT - CMC/AUTO
ATT DB - MIN
MAN ATT(3) - RATE CMD

10

V62E

11

V49E

12

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

13

F 50 18 REQ MNVR TO FDAI RPY ANGLES (.01°)
(AUTO) PRO
(MAN) SC CONT - SCS
BMAG MODE (3) - RATE 2
MNVR To 15

14

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

15

F 50 18 REQ TRIM TO FDAI RPY ANGLES (.01°)
(TRIM) Go to 13
(BYPASS) ENTR

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CSM

- 16 CHECK BORESIGHT & SXT STARS
OPTICS PWR - on (up)
OPT MODE - CMC
OPT ZERO - OFF
- 17 V41 N91E
- 18 F 21 92 SHAFT, TRUN (.01°, .001°)
Load SXTS angles
- 19 41 OPTICS DRIVE
Check SXT STAR
OPT ZERO - ZERO
Check BORESIGHT STAR (if avail)
- 20 V25 N17E (.01°)
Load Pad Data GMBL Angles
for CM BURN ATT
ATT SET tw - SET
to PAD DATA GMBL ANGLES
for CM BURN ATT
- 21 PWR REDUCTION
MN BUS TIE (2) - ON
HGA PWR - OFF
FC PUMPS (3) - OFF
FC 2 MN A&B - OFF
Verify loads balanced
S BD PWR AMP - LOW
cb ECS RAD CONT/HTR (2) - open
cb WASTE H2O/URINE DUMP HTRS (2) - open
cb HTRS OVLD (2) - open
POT H2O HTR - OFF
GLY EVAP TEMP IN - MAN
HTR SERV TSK 1 - START
GMBL HTR (2) - START

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P41 - RCS THRUSTING
V37E 41E

22

23 F 50 18 REQ MNVR TO LCL HORIZ (HDS DN) (.01°)
(AUTO) BMAG MODE (3) - RATE 2
SC CONT - CMC/AUTO
PRO To 24
(MAN/DAP) BMAG MODE (3) - RATE 2
SC CONT - CMC/HOLD
V62E
MNVR To 25

24 06 18 AUTO MNVR TO FDAI RPY (.01°)

25 F 50 18 REQ TRIM TO LCL HORIZ (.01°)
ALIGN SC ROLL
(AUTO TRIM) PRO To 24
(BYPASS) ATT DB - MIN
RATE - LOW
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/RATE 2
ENTR

55:00m

26 06 85 VGX,Y,Z (.1fps)

RECHECK BORESIGHT STAR
TRANS CONTR PWR - on (up)
EMS MODE - STBY (verify)
EMS FUNC - ΔV SET/VHF RNG
SET ΔV for SM BURN
EMS FUNC - ΔV
S BD ANT - OMNI C
SECS LOGIC (2) - ON
MSFN confirm Go for PYRO ARM
SECS PYRO ARM (2) - ARM
CM RCS LOGIC - ON (verify)

59:25

27

DSKY BLANKS

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CSM 106

59:30
28 16 85 VG X,Y,Z (AVE G ON) (.1fps)
RHC's & THC - ARMED
LIMIT CYCLE - OFF
TAPE RCDR - CMD RESET/HBR
EMS MODE - NORMAL

00:00
29 F 16 85 REQ NULL VG X,Y,Z (.1fps)
BURN EMS AV CTR TO ZERO
RESET DET & COUNT UP

If SM ONLY burn go to step 32

THC - LOCKED
SC CONT - SCS/FREE
RATE - HIGH
PRIM GLY To RAD - BYPASS (verify)
MN BUS TIE (2) - ON (verify)
CM/SM SEP (2) - on (up)
If docking ring still on:
CSM/LM FNL SEP (2) - on (up)(verify)

MAN ATT (3) - MIN IMP
BMAG MODE (3) - RATE 2

C&W MODE - CM
RCS TRNFR - CM
CM RCS LOGIC - OFF

Monitor VM A/B:

If <25 vdc, go to EMERG
POWER DOWN Pg E/6-1

V63E

* If CMC NO GO: *
* FDAI SOURCE - ATT SET *
* FDAI SEL - 1 or 2 *
* ATT SET - GDC *

MAN ATT PITCH - ACCEL CMD
FDAI SCALE - 5/5
MNVR TO CM BURN ATT(NULL ERR NEEDLES)
R 0°
P
Y 0°

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30 CM RCS BURN
 RHC #1-Continuous Pitch Down
 RHC #2-Module Pitch to null needles
 BURN VGZ TO ZERO
 * If only 1 RHC *
 * Pulse + P=5° from retro att.*
 * Maintain rates <3°/sec *

31 BURN COMPLETION AT:
 AV CTR= _____ or DET= _____

V82E

32 F 16 44 HA,HP,TFF (.1nm,min-sec)
 Check HP:
 If > Pad data, continue burn
 until < Pad

PRO

33 F 16 85 VGX,Y,Z (.1fps)
 Read VG residuals to MSFN
 (HYBRID) PRO to 34

(SM ONLY BURN)

PRO

F 37 OOE

EI-15:00 V37E 47E
 F 16 83 AVX,Y,Z (.1fps)

SC CONT - SCS/FREE
 MAN ATT (PITCH) - RATE CMD
 RATE - HIGH
 PRIM GLY To RAD - BYPASS (verify)
 MN BUS TIE (2) - ON (verify)
 CM/SM SEP (2) - ON
 If docking ring still on:
 CSM/LM ENL SEP (2) - on (up) (verify)
 MAN ATT (3) - MIN IMP
 BMAG MODE (3) - RATE 2
 C&W MODE - CM
 RCS TRNFR - CM
 CM RCS LOGIC - OFF
 SECS PYRO ARM (2) - SAFE

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CSM 6

E
3-7

PRO

Monitor VMA/B:

If <25 vdc go to EMERG
POWER DOWN Pg E/6-1

34 F 37

OOE

PCM BIT RATE - LOW

ATT DB - MAX

EMS MODE - STBY

EMS FUNC - ~~ONE~~ *RNG SET*

Go To EARTH ORBIT ENTRY, pg E/5-1

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CSM 106

NORMAL DEORBIT

VEHICLE PREP COMPLETE

P30 - EXTERNAL AV

1 V37E 30E

2 F 06 33 GETI (hr,min,.01sec)
(ACCEPT) PRO
(REJECT) LOAD DESIRED GETI

3 F 06 81 AVX,Y,Z (LV) (.1fps)
(ACCEPT) PRO
(REJECT) LOAD DESIRED GETI

4 F 06 42 HA,HP,AV (.1nm,.1fps)
Record AV _____
(ACCEPT) PRO
(REJECT) Reselect P30 or P27. Load new param.

5 F 16 45 M,TFI,MGA (marks,min-sec,.01°)
*MGA -00002: If *
* IMU not aligned*
SET DET
PRO

F 37 00E

6 SEPARATION CK LIST

PRIM GLY TO RAD - BYPASS (pull)
PLSS 02 vlv - FILL
02 SM SUPPLY vlv - OFF
CAB PRESS REL vlv (2) - NORM
cb ELS (2) - close (verify)
cb SECS ARM (2) - close (verify)
cb SECS LOGIC (2) - close (verify)
ROT CONTR PWR NORM 1&2 - AC/DC
ABORT SYS PRPLNT - RCS CMD
SM RCS SEC' PRPLNT (4) - OPEN
VHF AM A&B - off (ctr)

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7

CM RCS CHECK

AUTO RCS A/C ROLL (4) - OFF (verify)
cb RCS LOGIC (2) - closed (verify)
SC CONT - SCS
RCS TRANSFER - CM
AUTO RCS SEL (RING 1) - OFF
AUTO RCS SEL (RING 2) - MNB
TEST RING 2 THRUSTERS
AUTO RCS SEL (RING 2) - OFF
AUTO RCS SEL (RING 1) - MNA
TEST RING 1 THRUSTERS
RCS TRANSFER - SM

AUTO RCS SEL (RING 2) - MNB

8

SPS THRUSTING PREP

CYCLE CRYO FANS
SPS GAGING - AC1 (verify)
PUG MODE - NORM (verify)
BMAG MODE (3) - RATE 2
AV CG - CSM
CMC MODE - FREE
AUTO RCS SEL (16) - MNA or MNB
(liftoff config)
SC CONT - CMC/AUTO

9

MNVR TO PAD BURN ATT
V62E

10

V49E

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

12 F 50 18 REQ MNVR TO FDAI RPY ANGLES (.01°)
(AUTO) PRO
(MAN) SC CONT - SCS
MNVR to 14

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

14 F 50 18 REQ TRIM TO FDAI RPY ANGLES (.01°)
(TRIM) Go to 12
(BYPASS) ENTR

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CSM 106

- 15 BORESIGHT STAR CHECK
- 16 V37E 40E
 OPT PWR - OFF
- 17 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (AUTO) BMAG MODE (3) - RATE 2
 SC CONT - CMC/AUTO
 PRO to 18
 (MAN/DAP) BMAG MODE (3) - RATE 2
 SC CONT - CMC/HOLD
 MNVR to 19
 (MAN/SCS) SC CONT - SCS
 MNVR to 19
- 18 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
- 19 F 50 18 REQUEST TRIM MNVR TO FDAI RPY ANGLES
 ALIGN S/C ROLL (.01°)
 GDC ALIGN

TVC CHECK & PREP

cb STAB CONT SYS (all) - close (verify)
cb SPS (12) - close
ATT DB - MIN
RATE - LOW
LIMIT CYCLE - ON
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/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
MN BUS TIE (2) - ON
TVC SERVO PWR 1 - AC1/MNA
 2 - AC2/MNB
TRANS CONTR PWR - ON
ROT CONTR PWR NORMAL 2 - AC
RHC #2 - ARMED

+54:00m
(-06:00)

CSM 1
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TIG-5min

HORIZ CHK - Horiz on 12° window
mark (Limit +3° PNGCS GO/NO GO)
If NO GO set tw 180°, 180°, 0°
Track horiz with 24° window mark
At TIG-2 min Align GDC

55:00m
(-05:00)

PRIMARY TVC CHECK

GMBL MOT P1-Y1 -START/ON(LMP confirm)
If SCS, verify Thumbwheel Trim
THC - CW
Verify NO MTVC

SEC TVC CHECK

GMBL MOT P2-Y2 -START/ON(LMP confirm)
SET GPI TRIM
Verify MTVC
THC NEUTRAL
GPI returns to 0,0 (CMC) or trim (SCS)
ROT CONT PWR NORM 2 - AC/DC
(TRIM) Go to step 17
(BYPASS) BMAG MODE(3) - ATT1/RATE2 (verify)
ENTR

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

Monitor GPI Response:

00,02,-02,00,02,02,00,Trim

*TEST FAIL: *

*SC CONT - SCS *

SCS TVC (2) - AUTO

(REJECT) ENTR

21 06 40 TFI,VG,AVM (min-sec,.1fps)

PROG ALM - TIG slipped

*V5N9E 01703 *

*KEY RLSE To 21 *

ROT CONTR PWR DIRECT (2) - MNA/B

SPS He vlvs (2) - AUTO (verify)

LIMIT CYCLE - OFF

FDAI SCALE - 50/15

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Changed May 3, 1969

CSM 106

58:00
(-02:00)

ΔV THRUST A(B) - NORMAL
THC - ARMED
RHC (2) - ARMED
TAPE RCDR - CMD RESET/HBR

59:25
(-00:35)

DSKY BLANKS

59:30
(-00:30)

(AVE G ON)
EMS MODE - NORMAL

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

59:XX
(-00:XX)

ULLAGE AS REQ

*IF NO ULLAGE: *
DIR ULLAGE PB - PUSH
*CONTROL ATT W/RHC *
MONITOR ΔVM (R3) COUNTING UP

59:55
(-00:05)

F 99 40 ENG ON ENABLE REQUEST
(AUTO IGN) PRO AT TFI ≥0 sec
(BYPASS IGN) ENTR to 24

22 00:00

IGN

If SCS - THRUST ON 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 LITE - ON

Basic Date April 18, 1969
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MONITOR THRUSTING

Pc 95-105 psia
EMS COUNTING DOWN
SPS INJ vlvs (4) - OPEN
SPS He vlvs tb (2) - gray
SPS FUEL/OXID PRESS - 175-195 psia
PUGS - BALANCED

*PROG ALARM *
V5N9E 01407 VG INC
THC - CW, FLY MTVC

ECO

*EMER SPS CUTOFF: *
* ΔV THRUST (2) - OFF*

23 F 16 40 TFC(STATIC),VG,ΔVM (min-sec,.1fps)
ΔV THRUST A/B - OFF
SPS INJ vlvs (4) - CLOSED
SPS He tb (2) - bp
cb SPS P2,Y2 - closed (verify)
GMBL MTRS (4) - OFF
TVC SERVO PWR 1&2 - OFF
cb SPS P&Y (4) - open

PRO

24 F 16 85 VG XYZ(CM) (.1fps)
NULL RESIDUALS
RECORD ΔV CTR & RESIDUALS ΔVC
EMS FUNC - RNG SET VGX
EMS MODE - STBY VGY
BMAG MODE (3) - RATE 2
ATT DB - MAX VGZ
TRANS CONT PWR - OFF

PRO

25 F 37 V82E

26 F 16 44 HA,HP,TFF (.1nm,min-sec)
R3-59B59 HP >49.4 nm

PRO

27 F 37 OOE

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CSM 106

EARTH ORBIT ENTRY

1 Verify CM/SM SEP ATT (Norm Deorb Only)

R _____ (180°)

P _____

Y _____ (0°)

2 EMS INITIALIZATION

EMS FUNC - RNG SET (*verify*)

SET RNG TO PAD DATA RNG

EMS FUNC - Vo SET

Slew scroll to pad data VIO

EMS FUNC - ENTRY

3 RSI ALIGNMENT

FDAI SOURCE - ATT SET

ATT SET - GDC

EMS ROLL - on(up)

GDC ALIGN PB - PUSH & HOLD

YAW tw - Position RSI thru 45° &
back to LIFT UP

GDC ALIGN PB - RELEASE

EMS ROLL - OFF

Align GDC to IMU

4 PWR REDUCT (Norm Deorb Only)

HGA PWR - OFF

FC PUMPS (3) - OFF

FC 2 MN A&B - OFF

Verify loads balanced

~~FC 2 MN~~

S BD PWR AMP - Low

cb ECS RAD CONT/HTR (2) - open

cb WASTE H2O/URINE DUMP HTRS (2)-open

cb HTRS OVLD (2) - open

POT H2O HTR - OFF

GLY EVAP TEMP IN - MAN

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P61 - ENTRY PREP

5

V37E 61E

05 09 01427 - ROLL REVERSED
*05 09 01426 - IMU UNSAT *

6

F 06 61 IMPACT LAT, LONG, HDS UP/DN (+/-)
(.01°, .01°, +00001)

PAD VALUES

LAT _____
LONG _____
HDS UP/DN _____

PRO

7

F 06 60 GMAX, V400K, GAMMA EI (.01G, .fps, .01°)

Record

GMAX _____
V400K _____
GAMMA EI _____

PRO

8

F 06 63 RTOGO (.1mm) _____ PAD _____

VIO (fps) _____ PAD _____

TFE (min-sec) _____

Compare with MSFN for PGWS GO/NO GO

RTOGO should agree with pad
value within 20mm

VIO should agree within 15fps

NO COMM, SET RTOGO & VIO IN EMS &

INITIALIZE

(ACCEPT) PRO (UPDATE TFE) V32E to 8

P62 - CM/SM SEP & PRE-ENTRY MNVR

9

F 50 25 For Hybrid Deorbit, PRO to 10

00041 REQUEST CM/SM SEP

SC CONT - SCS/FREE

YAW - 45° out-of-plane (left for RCS,
right for SPS)

RATE - HIGH

ATT DB - MIN

MAN ATT (3) - RATE CMD

BMAG MODE (3) - ATT1/RATE2

PRIM CLY to PAD - BYPASS

Basic Date April 18, 1969
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CMS 106

If <25vdc go to EMERG POWERDOWN

Pg E/6-1

ATT DB - MAX
EMS DATA - Verify
EMS FUNC - ENTRY (verify)
EMS MODE - NORMAL
MAINTAIN HORIZ TRK
MAN ATT (3) - RATE CMD
PRO (Act ENTRY DAP)

Basic Date April 18, 1969
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PRO

11 POSS 06 22 FINAL ATT DISP, RPY (.01°)
(Only if X-axis beyond 45° of Vel vector)

P63 - ENTRY INIT

12 06 64 G,VI,RTOGO (.01G,fps,.1nm)
 FDAI SCALE - 50/15
 ROT CONTR PWR DIR (both) - MNA/MNB
 TAPE RCDR - CMD RESET/HBR
 HORIZ CK
 Pitch error needle goes toward
 zero approaching .05G time

If CMC is GO:

SC CONT - CMC/AUTO

*If DAP NO GO: *

* SC CONT - SCS*

* FLY BETA *

*If CMC NO GO: *

* SC CONT - SCS*

* FLY EMS *

RCS Deorb: Roll HDS UP

TRACK HORIZ with 29° window mk

P64 - ENTRY POST .05G

13 RTOGO AT .05G AGREES WITH EMS - verif
 HORIZ CK
 .05G Lt - on (EMS start)

.05G time

(+0__:_:_)

No EMS start within 3 secs

*EMS MODE - BACKUP/VHF RNG *

.05G sw - on (up)

EMS ROLL - on (up)

06 68 BETA, VI, HDOT (.01°,fps,fps)

Compare RSI & FDAI

If CMC or PAD cmds Lift DN,

MNVR Lift DN

EMS GO/NO GO

G-V Plot within limits

(V<27K fps) Go To 17

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P65 - ENTRY - UP CONT (V>27K fps)

14 F 16 69 BETA (.01°) _____
DL (.01G) _____ PAD _____
VL (fps) _____ PAD _____
*IF NO AGREEMENT: *
*SC CONT - SCS *
*FLY EMS *
PRO

15 06 68 BETA, VI, HDOT (.01°,fps,fps)
(V<VL +500 fps & RDOT Neg) Go To 17

P66 - ENTRY - BALLISTIC (D<DL)

16 06 22 DESIRED GMBL ANGLES RPY (.01°)
Monitor horiz +12° of 31.7° mark

P67 - ENTRY - FINAL PHASE (0.2G)

17 06 66 BETA,CRSRNG ERR,DNRNG ERR (.01°, .1nm, .1nm)
KEY VERB
Record DNRNG ERR _____
KEY RLSE
Limit: +100nm from PAD DRE
Monitor lift vector on RSI & FDAI
CM RCS: Change rings when He Press
<1150 psia

F 16 67 RTOGO,LAT, LONG (Vrel=1000fps)
(.1nm, .01°, .01°)

SC CONT - SCS
RTOGO NEG- LIFT UP
RTOGO POS - LIFT DOWN
Monitor altimeter
Record LAT, LONG & voice to RECY at 10K'
Record EMS RTOGO
EMS MODE - STBY
EMS FUNC - OFF

Go To EARTHLANDING pg E/7-1

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Δ Time-to-reverse bank angle, Δ RETRB, sec

40

30

20

10

0

-10

Backup bank angle, BBA, deg

90

80

70

60

50

40

-500

-400

-300

-200

-100

0

100

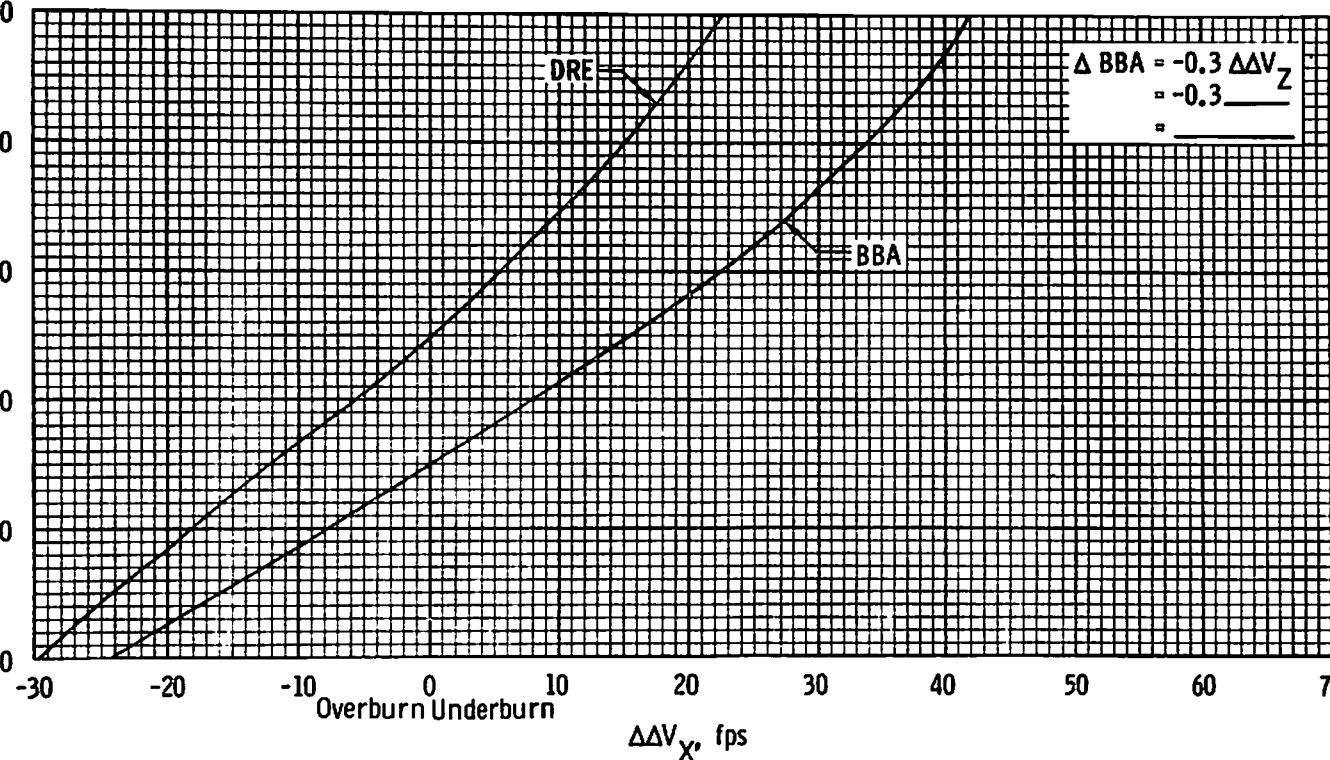
200

300

400

500

Downrange error, DRE at 0.2g, n. mi.



Overburn Underburn

$\Delta\Delta V_x$, fps

Earth orbit BBA versus $\Delta\Delta V_x$.

EARTHLANDING

90K' (0:00) Start DET
 FRT (06:52) STEAM PRESS - PEGGED
 50K' (01:00) CABIN PRESS REL vlv (2) - BOOST/ENTRY
SECS PYRO ARM (2) - ARM
 Check Altimeter

40K' (01:15) * CM UNSTABLE *
 *RCS CMD - OFF *
 * 40K' APEX COVER JETT PB-PUSH *
 DROGUE DEPLOY PB - PUSH (2 sec
 *after apex cover jett) *

30K' ELS LOGIC - on (up)
 ELS - AUTO

24K' (01:46.) RCS disable (auto)
 (08:38) *RCS CMD - OFF*

Apex cover jett (auto)
 APEX COVER JETT PB - PUSH
 (WAIT 2 SECS)
 Drogue parachutes deployed (auto)
 DROGUE DEPLOY PB - PUSH

If Both Drogues Fail:

*ELS - MAN *
 *Stabilize CM *
 5K' MAIN DPLY PB - PUSH
 *ELS - AUTO *

23.5K' Cabin Pressure increasing (Drogues + 50s)
 *If not increasing by 17K': *
 CABIN PRESS REL vlv (RH) - DUMP

10K' (02:31) Main parachutes deployed
 (09:23) MAIN DEPLOY PB - PUSH (within 1 sec)
 VHF ANT - RECY
 VHF AM A - SIMPLEX
 VHF BCN - ON
 CABIN PRESS REL vlv (2) - CLOSE

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CSM 106

CM RCS LOGIC - on (up)
CM PRPLNT - DUMP (burn audible)
Monitor CM RCS 1&2 for He press decrease

*NO BURN or PRESS DECREASE *

* USE BOTH RHC's *

*DO NOT FIRE PITCH JETS *

CM PRPLNT-PURGE (to zero He press)

*CM RCS He DUMP PB - PUSH *

*RHC (2) - 30 secs *

* NO PITCH *

STRUT LOCKS (4) - UNLOCK

If night landing:

cb FLOAT BAG 3 FLT/PL - close

*PL BCN LT - HIGH *

cb FLT & PL BAT BUS A,B,&BAT C (3) -close

cb FLT & PL MNA & B (2) - open

cb RAD HTR OVLD (2) - open (verify)

cb SPS P&Y (4) - open (verify)

cb BAT RELAY BUS (2) - open

3K' CABIN PRESS REL vlv (RH) - DUMP (after purge
completed)

FLOOD Lts - POST LDG

CM RCS PRPLNT (2) - OFF

800' CAB PRESS RELF vlv - CLOSE (latch off)
MN BUS TIE (2) - OFF

AFTER LANDING:

cb MAIN REL PYRO (2) - close

MAIN RELEASE - on(up)

Go to POSTLANDING pg E/7-3

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POSTLANDING

STABILIZATION, VENTILATION, COMMUNICATIONS

1

Stabilization after landing

ELS - AUTO (verify)

cb MAIN REL PYRO (2) - close (verify)

MAIN RELEASE - on (up) (verify)

SECS PYRO ARM (2) - SAFE

SECS LOGIC (2) - OFF

No contact with recovery forces

*VHF AM A&B - off (ctr) *

*VHF AM RCV ONLY - A *

cb PL VENT - close

cb FLOAT BAG (3) - close

cb UPRIGHT SYS COMPRESS (2) - close

If Stable II:

FLOAT BAG(3)-FILL till 2 min after
upright, then - OFF

VHF AM A/B & BCN - OFF while inverted

If Stable I:

After 10 Min Cooling Period,

FLOAT BAG (3) - FILL 7 min, then OFF

2

Post Stabilization And Ventilation

PL BCN LT - BCN LT LOW

PL VENT vlv - UNLOCK (Pull)

Remove PL VENT Exh Cover

PL VENT - HIGH or LOW

PL DYE MARKER - ON (swimmer comm)

Release footstraps and restraints

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cb MNA BAT BUS A & BAT C (2) - open
 cb MNB BAT BUS B & BAT C (2) - open
 cb FLT & PL BAT C - open
 cb PYRO A SEQ A - open
 cb PYRO B SEQ B - open
 *EACH HR - CHECK DC VOLTS \geq 27.5 V *
 *If Not: *
 * cb FLT & PL-BAT BUS A&B (2) -open*
 * cb FLT & PL BAT C (1) - ~~open~~ close*
 * GO TO LOW POWER CHECKLIST *
 Unstow and install PLV DISTRIB DUCT
 Deploy grappling hook and line if req.

3

Post Landing Communications

VHF ANT-RECY (verify)

VHF BCN - ON (verify)

If no contact with recovery forces
 perform VHF BEACON Check

MONITOR VHF BEACON transmission

with VHF AM B Rcvr and/or Survival
 Transceiver

*VHF Beacon not operating *
 connect Survival Transceiver to ant
 *cable behind VHF ant access pnl *
 *and place radio in BCN mode *

LOW POWER CHECKLIST

VHF BCN - OFF

VHF AM (3) - RCV

FLOOD Lts - OFF

VHF AM A&B - off (ctr)

VHF AM RCV ONLY - A (verify)

COUCH LIGHTS - OFF

POSTLANDING VENT SYS: minimize use

SURV RADIO - plug into VHF BCN ANT cable
 conn behind VHF ant access pnl & turn radio
 on in BCN mode

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 Changed 12 3, 1969

EGRESS PROCEDURES

CMP	PL VENT - OFF
LMP	cb Pnl 250 (all) - open

STABLE I

ALL	Disconnect umbilicals Neck dam on (if suited)
CMP	Center couch - 270° position
CDR, LMP	Armrests stowed
CDR	Connect raft to S/C, if desired, with green lanyard Connect raft white lanyards to suits & inflate water wings when exiting
LMP	Connect rucksacks together to yellow lanyard on raft bag
CMP	GN2 RATCHET HNDL - CW GN2 VLV HNDL - UNLATCH & PUSH (Outbd) Side Hatch opened ACTR HNDL SEL - N Egress with liferaft
LMP	Put hardware kit out
LMP, CDR	Egress

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or C. STABLE II

LMP cb CREW STA AUDIO (3) - open
ALL Disconnect umbilicals
 Couch seat pans (3) - 170° position
 Neck dam on (if suited)
CMP Arm rests stowed
 Survival kits removed from stowage
CDR Connect life raft mainline to CDR or S/C
CMP Connect first white lanyard from
 life raft to suit
CDR Connect third white lanyard from
 life raft to suit
LMP Connect rucksacks together to yellow
 lanyard on raft bag
CMP PRESSURE EQUALIZATION vlv - OPEN
CMP, LMP Remove and stow fwd hatch
CMP Exit feet first with rucksacks; when clear
 of S/C inflate water wings and raft
LMP Exit feet first; when clear of S/C
 inflate water wings
CDR Exit feet first; when clear of S/C
 inflate water wings

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Changed - May 3, 1969

ENTRY EMERGENCY PROCEDURES

CM RCS FAILS TO PRESSURIZE OR FEED PRPLNT

1. Verify electrical power for pressurization
 - cb EPS BAT BUS (2) - close (Pnl 229)
 - cb PYRO A/B SEQ A/B (2) - close (Pnl 250)
 - cb SECS ARM (2) - close (Pnl 8)
 - SECS PYRO ARM (2) - ARM
 - SECS LOGIC (2) - on (up)
2. Cycle CM RCS - PRESS (Pnl 2)
3. Verify electrical power to CM RCS prplnt vlvs
 - cb EPS GRP 1&3 - close (Pnl 229)
 - cb SM RCS HTR A&B - close (Pnl 8)
 - cb RCS PRPLNT ISOL (2) - close
4. Cycle CM RCS PRPLNT 1&2 - on (up) (Pnl 2)
5. Open He & PRPLNT Crossfeed
 - cb EPS GRP 5 - close (Pnl 229)
 - cb RCS LOGIC (2) - close (Pnl 8)
 - CM RCS LOGIC - on (up) (Pnl 1)
 - CM PRPLNT - DUMP (momentarily, then OFF)

EMERGENCY POWERDOWN

(MN BUS voltage <26.0 vdc, no short verified)

	<u>Amps</u>
S BD PWR AMP - off (ctr)	4.35
SEC COOL EVAP - RESET for 58	4.26
sec, then OFF	
SEC COOL PUMP - OFF	
SUIT COMPR (2) - OFF	8.44
DIRECT O2 vlv - ON (if suited)	
TAPE RCDR FWD - off (ctr)	1.69
POT H2O HTR - OFF	1.62
LIGHTS - (min req'd)	
cb G&N OPT (2) - open	3.0 3.1
ECS GLY PUMPS (2) - OFF	2.76 per pump
PWR SCE - off (ctr)	0.70
TELECOM GRP 1&2 - OFF	1.8 1.8
cb INSTR ESS (2) - open	1.10

Note: After 0.05G, cb G&N (8) - open

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Changed May 3, 1969

CSM 10

BUS LOST RECONFIGURATION

A. Loss of MN BUS A

FC 2 - MNB only
FC 1 (MNA&B) - off (ctr) (on line
for deorbit burn)
INV 3 - MNB, AC1
cb MNA BAT BUS A - open
cb MNA BAT C - open
cb MNB BAT C - closed
cb BAT C BAT BUS A - closed
AUTO RCS SEL (desired thrusters) - MNB
FDAI SEL - 2
RHC PWR DIR (2) - MNB
BMAG MODE (3) - RATE 2

B. Loss of MN BUS B

FC 2 - MNA only
FC 3 (MNA&B) - off (ctr)(on line for
deorbit burn)
INV 3 - MNA, AC2
cb MNB BAT C - open
cb MNB BAT BUS B - open
cb BAT C BAT BUS B - closed
cb MNA BAT C - closed
AUTO RCS SEL (desired thrusters) - MNA
FDAI SEL - 1
RHC PWR DIR 1 - MNA
SCS ELEC PWR - ECA
BMAG MODE (3) - RATE 1

C. Loss of BAT BUS A

Prepare for two battery entry
AUTO RCS SEL (desired thrusters) - MNB
After CM/SM SEP
RCS TRNFR - CM (mom)
At APEX COVER JETT
cb SCS CONTR/AUTO (2) - open

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- D. Loss of BAT BUS B
Prepare for two battery entry
AUTO RCS SEL (desired thrusters) - MNA
After CM/SM SEP
RCS TRNFR - CM (mom)
At APEX COVER JETT
cb SCS CONTR/AUTO (2) - open
- E. Loss of AC BUS 1
AC INV 1 MNA - OFF
BMAG MODE (3) - RATE 2
FDAI SEL - 2
SUIT COMPR 2 - AC2
S BD NORM XPNDR - SEC
S BD NORM PWR AMP - SEC
ECS GLY PUMP 2 - AC 2
G/N PWR - AC2
- F. Loss of AC BUS 2
AC INV 2 MNB - OFF
FC PUMP 2&3 - AC1
FDAI SEL - 1
BMAG MODE (3) - RATE 1
G/N PWR - AC1
S BD NORM XPNDR - PRI
S BD NORM PWR AMP - PRI

Basic Date April 18, 1969
Changed May 3, 1969

EMERGENCY SAFE OF APEX COVER JETT

If MSFN NO GO For Pyro Arm Indicates Apex
Cover Jettison,
SECS LOGIC (2) - OFF
cb ELS (2) - open
SECS LOGIC (2) - ON
If MSFN GO, Go To Step A
If Still Apex Cover Jettison,
cb SECS LOGIC A - open
If MSFN GO, Go To Step B
If Still Apex Cover Jettison,
cb SECS LOGIC A - close
cb SECS LOGIC B - open
If MSFN GO, Go To Step C
If Still Apex Cover Jettison,
ELS - MAN
ELS LOGIC - OFF
SECS LOGIC (2) - OFF
cb SECS LOGIC (2) - open
cb SECS ARM (2) - open
CMP To LEB
cb SEQ A&B PYRO A&B (2) - open (Pnl 250)
Verify PYRO BUS A&B voltage = 0
Use Tool E, (5/32 allen head) to remove
closeout panel located beneath panels
276 & 277 (approx 10 fasteners on panel).
Remove, or cut all wires to, connector
marked "cut" with white tag (P545). Tape
ends of any wires cut. Replace closeout
panel.
cb SEQ A&B PYRO A&B - close
Verify PYRO BUS A&B voltage >35 vdc
cb ELS (2) - close
cb SECS LOGIC (2) - close
cb SECS ARM (2) - open (verify)
DO NOT ARM PYRO BUSES

Basic Date April 18, 1969
Changed March 3, 1969

Continue Normal Entry Except,

Perform CM RCS pressurization & CM/SM
Separation together at which time ARM
PYRO's in the following manner:

SECS PYRO ARM (B) - SAFE (verify)
SECS PYRO ARM (A) - ARM

To Jettison Apex Cover At 24K':
SECS PYRO ARM (B) - ARM

STEP A

cb ELS (2) - open (verify), close
at or after apex cover jettison
at 24K'

Continue normal entry

STEP B

cb SECS LOGIC A - open (verify),
close at or after apex cover jettison
at 24K'

Continue normal entry

STEP C

cb SECS LOGIC B - open (verify), close
at or after apex cover jettison
at 24K'

Continue normal entry

Basic Date April 18, 1969
Changed

FIRE/SMOKE IN CM DURING ENTRY

1 CABIN FAN (2) - OFF (verify)

[WARNING: CM water must
not be used to extinguish
fire]

2 Monitor EPS indicators for excessive current.
Immediately remove power from affected bus.

3 ROT CONTR PWR DIRECT (2) - MNA/MNB
& maintain attitude if required.

4 If affected bus is:

MNA

AC INV 1 AC BUS 1 - OFF

AC INV 2 AC BUS 1 - on (up)

Set up for CM/RCS sys 2

AUTO RCS SEL A/C ROLL (4) - OFF

AUTO RCS SEL CM 1(6) - OFF

AUTO RCS SEL CM 2(6) - MNB

RCS dump is fuel rich

MNB

AC INV 2 AC BUS 2 - OFF

AC INV 1 AC BUS 2 - on (up)

RCS dump is oxidizer rich

5 CAB PRESS REL vlv (RH) - DUMP

6 Continue ENTRY

Basic Date April 18, 1969

Changed

CONTINGENCY EVA

A CM PREP FOR CONTINGENCY EVA

- 1 PGA Bag Stowed
- 2 EVA Stabilizer Strut installed
- 3 Center Couch removed and stowed under L Couch
- 4 C AND R SUIT FLOW vlv are OFF, VERIFY INTERCONNECTS
INSTALLED
- 5 GN2 VLV HANDLE - PULL
- 6 REMOVE PIP PIN, STOW IN R-3
- 7 L and R Couch - 270 degree
- 8 Jack Screws fully opened, tethered, and accessible
- 9 Tool B tethered and accessible
- 10 Unstow CM INGRESS/EGRESS BAR
- 11 SUIT FLOW vlv - CABIN FLOW
- 12 SUIT RETURN vlv - OPEN (pull)
- 13 EMER CAB PRESS SEL - BOTH
- 14 ECS HOSES - RED/RED, BLUE/BLUE

B SYSTEM PREPARATION FOR DEPRESS

- 1 COMM: SIMPLEX A, VERIFY CM/LM COMM
- 2 O2 PRESS IND sw - SURGE TANK
- 3 CRYO TK O2 PRESS 1 IND - 865-935 psi
- 4 Verify REPRESS O2 PRESS - 865-935 psig
- 5 Select Attitude Control Mode and
Manuever Spacecraft to EVT Attitude
- 6 AUTO RCS SELECT -
UNDOCKED
A/C ROLL - A1, A2 - OFF
PITCH - A3, - OFF
YAW - B3 - OFF
DOCKED
ALL - OFF

C PLSS/OPS COMM CHECK (ON CDR REQUEST)

- 1 VHF AM A - DUPLEX
- 2 Verify VOICE COMM with LMP
(NO SIMUL RCV A&B, SIMP A-CDR,DUP A - LMP)

Basic Date April 18, 1969
Changed April 3, 1969

CSM 106

D FINAL SYSTEMS PREP FOR DEPRESS

- 1 Stow loose items
- 2 EXT APU/EVA LT - on (up) (if req'd)
- 3 EXT PMSZ LT - off (ctr)
- 4 Verify PGA FLOW DIVERTER vlv - HORIZONTAL
- 5 Verify Feedport Cover - Locked
- 6 Don Helmet and Shield
- 7 Don Gloves
- 8 Secure Helmet Stowage Bag
- 9 SUIT RETURN vlv - CLOSE (push)
- 10 EMERG CABIN PRESS SEL - OFF
- 11 Verify helmet, gloves, zipper, and hoses locked

E SUIT CKT INTEGRITY CHECK (Decal)

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

CAUTION

SUIT TEST vlv should remain
in the PRESS position until
suit circuit pressure is sta-
bilized to preclude seal scarring

If repositioning of SUIT TEST
vlv from PRESS is required
prior to suit pressure and O2
flow stabilization, perform
the following:

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

Basic Date April 18, 1969
Changed April 23, 1969

SUIT TEST vlv - PRESS
02 FLOW ind - 1.0 lb/hr (pegged)
02 FLOW HI lt - on
M/A - ON, Reset
Cycle SUIT CKT RTN AIR vlv OPEN
and CLOSE at suit press
of 1.5 to 2.0 psig
SUIT PRESS ind - 8.8-9.8 psia
PGA PRESS ind - 4.1-4.5 psig
02 FLOW HI lt - out
Allow 02 flow to stabilize 15 sec
02 flow shall remain below
0.8 lb/hr for 30 secs after
stabilization
SUIT TEST vlv - DEPRESS
02 FLOW ind - 0.2-0.4 lb/hr
SUIT PRESS - slightly > CAB PRESS
SUIT TEST vlv - OFF
02 DEMAND REG vlv - BOTH (verify)

F CABIN DEPRESS (Decal)

- 1 Confirm GO for Cabin Depress with CDR
- 2 Verify CABIN FAN (2) - OFF
- 3 PLSS 02 vlv - FILL
- 4 REPRESS 02 vlv - CLOSE
- 5 Verify CAB PRESS REL vlv (2) - NORMAL
(SAFETY LATCH ON)
- 6 SIDE HATCH DUMP vlv - OPEN
(02 FLOW HI Warning Light may come on
prior to Cabin Press Reg Lock-Up)
- 7 Monitor Cabin Pressure to 3.25 psia
- 8 At 3.25 psia, SIDE HATCH DUMP vlv - CLOSE
- 9 Verify 02 FLOW IND - < 0.5 LB/HR
- 10 Verify Cabin Pressure at 3.25 psia and CM Suit
Circuit Pressure Stable at 3.5-4.0 psia
- 11 SIDE HATCH DUMP vlv - OPEN
- 12 CABIN PRESS ind - 0.0 psia
- 13 SIDE HATCH DUMP vlv - CLOSE

Basic Date April 18, 1969
Changed April 3, 1969

CSM 106

G HATCH OPENING (Decal)

- 1 GN2 VLV HANDLE - PULL (verify)
Gauge reads min
- 2 LOCK PIN RELEASE KNOB - UNLOCK
- 3 Verify Lock Pin Indicator Released
- 4 Verify GEAR BOX SEL - UNLATCH
- 5 Verify ACTR HANDLE SEL - U
- 6 Unstow ACTR HANDLE
- 7 Unlock hatch slowly
- 8 Verify hatch unlocked
- 9 GEAR BOX SEL - LATCH
- 10 ACTR HANDLE SEL - L
- 11 Stow ACTR HANDLE
- 12 Open hatch to the full open position
- 13 CMP give GO for Transfer
- 14 Mark CDR OPS activation & record

H CONTINGENCY INGRESS

- 1 CDR Ingress To LEB
- 2 Secure Position, Manage Lifeline
- 3 CMP Stow CM INGRESS/EGRESS BAR
Before LMP Ingress
- 4 LMP Ingress CM, Center Couch Area
- 5 PLSS FEEDWATER vlv - CLOSED (up)
- 6 Connect R Electrical Umbilical
and verify COMM

I HATCH CLOSING (Decal)

- 1 Close hatch
- 2 Lock Hatch & verify Lock Pin dropped in
- 3 ACTR HANDLE SEL - N
- 4 Stow ACTR HANDLE
- 5 GEAR BOX SEL - LATCH (verify)

J CDR VAC TRANSFER TO CM ECS

If 20 minutes elapsed from initial OPS 02 opening,
connect CDR to ECS

- | | |
|--|---|
| *Verify SUIT FLOW - OFF | * |
| *Connect R 02 Umbilicals | * |
| *PURGE vlv - CLOSE | * |
| *SUIT FLOW vlv - FULL FLOW, verify flow* | |
| *OPS 02 SHUTOFF - CLOSE | * |

Basic Date April 18, 1969
Changed May 3, 1969

K CABIN REPRESS to 3.0 PSIA (Decal)

- 1 REPRESS 02 vlv - OPEN For 10 SEC Then CLOSE
(CABIN PRESS APPROX 1.0 PSIA)
- 2 CABIN PRESS ind - MONITOR FOR 30 SEC (Gross Leakage)
- 3 REPRESS 02 vlv - OPEN
- 4 CONTROL SURGE TANK PRESS GREATER THAN
150 PSIA)
- 5 REPRESS 02 - CLOSE
- 6 CABIN PRESS IND - 3.0 PSIA
- 7 DUMP OPS INTO CABIN IF AVAIL

L REPRESS FROM 3.0 PSIA TO 4.8 PSIA If OPS NOT AVAIL

- 1 CABIN REPRESS vlv - OPEN
- 2 MAINTAIN 150 PSIG MIN IN SURGE TK
- 3 CAB PRESS 4.7-5.3 psia
- 4 02 PRESS IND sw - TK 1
- 5 CAB REPRESS vlv - OFF
- 6 Go to Final Systems Config, Step Q.

M OPS REPRESS

STEPS N, O, P MUST BE ACCOMPLISHED

N CDR CONN TO ECS

- 1 VERIFY R SUIT FLOW - OFF
- 2 CONNECT R 02 UMB
- 3 OPS 02 vlv - CLOSE
- 4 DEPRESS USING PURGE VLV
- 5 SUIT FLOW vlv - FULL FLOW (verify flow)
- 6 PURGE vlv - CLOSE

O LMP CONN TO ECS

- 1 VERIFY C SUIT FLOW - OFF
- 2 PLSS 02 - OFF (up)
- 3 DEPRESSURIZE USING PURGE VLV
- 4 REMOVE OPS 02 HOSE & PURGE VLV
- 5 CONNECT C 02 UMB
- 6 SUIT FLOW vlv - FULL FLOW (verify flow)
- 7 PLSS PUMP - OFF
- 8 FAN - OFF

Basic Date April 18, 1969
Changed 7 3, 1969

CSM 106

P DISCONNECT OPS 02 HOSE AND HOLD

- 1 OPS 02 vlv - OPEN
- 2 CAB PRESS 4.7-5.3 PSIA
- 3 OPS 02 vlv - CLOSE

Q FINAL SYSTEMS CONFIGURATION

- 1 CABIN PRESS ind - 4.7-5.3 psia
- 2 PLSS 02 vlv - FILL
- 3 VERIFY REPRESS 02 INCREASING
- 4 EMER CABIN PRESS SEL - BOTH
- 5 SUIT RET vlv - OPEN (pull)
 - DOFF Gloves and Temp Stow
 - DOFF Helmets and EV VISORS and Temp Stow
 - Verify SURGE TANK PRESS
 - 865-935 psi
 - 02 PRESS IND sw - TK 1
 - EXT LTS - RUN/EVA - OFF

R PLSS/OPS DOFFING

1 OPS -

- Verify Antenna Stowed
- Verify OPS 02 Shutoff vlv - CLOSE
- Stow OPS 02 Hose
- Remove OPS Straps from PGA

2 PLSS/OPS -

- Stow PLSS Antenna
- Remove RCU from PGA
- Disconnect 02 and H2O Hoses
- DOFF PLSS
- Hold PLSS in Position for Restowage

WARNING

- Before Disconnecting RCU from PLSS,
- Verify
 - PUMP - OFF (down)
 - FAN - OFF
 - MODE SEL - POS 3

Basic Date April 18, 1969
Changed April 3, 1969

- 3 Disconnect RCU and Stow in Helmet Stowage Bag
- Stow O2 Plugs in PGA
- Stow PLSS O2 and H2O Hoses
- Stow PLSS COMM Umbilical
- Secure OPS O2 Actuator
- Stow OPS O2 Hose
- Temp Stow PLSS/OPS and OPS

S PREP FOR EQUIPMENT JETTISON

- 1 COMM CARRIER Donned
- 2 O2 Hoses Connected to PGA
- 3 Protective Plugs Installed In Left
PGA O2 Connectors
- 4 Stow Loose Items
- 5 Prepare all Equipment to Be Jettisoned
and Secure -
PLSS/OPS
OPS
EV VISORS (2)
Place RCU, PURGE vlv (2), OPS/PGA Straps,
CM ECS Interconnects, Lifeline and Waist
Tethers in Helmet Stow Bag

T PREP FOR DEPRESS: GO TO-(A)-AND COMPLETE REQ'D STEPS

U EQUIPMENT JETTISON

- Jettison Equipment -
- PLSS/OPS, Helmet Stowage Bag,
 - OPS
 - EV VISORS (2)

V FINAL CABIN CONFIGURATION

- 1 Reinstall Center Couch
- 2 Reinstall PGA Stowage Bag
- 3 Remove EVA Stabilizer Strut
- 4 Restow Tool B and Jack Screws
- 5 Install Hatch Pip Pin

Basic Date April 18, 1969
Changed 3, 1969

CSM 1106

EARTH ORBIT BLOCK DATA

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REMARKS:

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E.O.
BLOCK

Basic Date FEB. 24, 1969
Changed

REMARKS:

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REMARKS:

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REMARKS:

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Basic Date Feb. 24, 1969

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Basic Date 24, 1969

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REMARKS:

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Basic Date: 24, 1969

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REMARKS:

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BLOCK

Basic Date Feb. 24, 1969

Changed

REMARKS:

EARTH ORBIT BLOCK DATA

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REMARKS:

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BLOCK

REMARKS:

Basic Date Feb. 24, 1969

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X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C

E.O.
BLOCK

REMARKS:

Basic Date: 24, 1969

Changed

EARTH ORBIT BLOCK DATA

X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C

REMARKS:

EARTH ORBIT BLOCK DATA

X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C

E.O.
BLOCK

Basic Date 24, 1969

Changed

REMARKS:

EARTH ORBIT BLOCK DATA

X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C

REMARKS:

EARTH ORBIT BLOCK DATA

X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C

E.O.

BLOCK

Basic Date Feb. 24, 1969

Changed

REMARKS:

EARTH ORBIT BLOCK DATA

X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C

REMARKS:

EARTH ORBIT BLOCK DATA

X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C
X	X					X	X					AREA
X	X	X				X	X	X				LAT
X	X					X	X					LONG
												GETI
X	X	X				X	X	X				ΔV_C

E.O.
BLOCK

REMARKS:

Basic Date Feb. 24, 1969

Changed

X		-		X		-	AREA
X	X	-	.	X	X	-	ΔV TO
X	X	X		X	X	X	R .05G
X	X	X		X	X	X	P .05G
X	X	X		X	X	X	Y .05G
+			.	+		.	RTGO EMS
+				+			V10
X	X		.	X	X	.	RET .05G
	0		.		0	.	LAT N61
			.			.	LONG
X	X		.	X	X	.	RET 0.2G
			.			.	DRE (55°) N66
R	R		/	R	R	/	BANK AN
X	X		.	X	X	.	RETRB
X	X		.	X	X	.	RETBBO
X	X		.	X	X	.	RETEBO
X	X		.	X	X	.	RETDROG
X	X	X		X	X	X	(90°/fps) CHART
X	X			X	X		DRE (90°)UPDATE

POST BURN

X	X	X		X	X	X	P .05G
+			.	+		.	RTGO EMS
+				+			V10
X	X		.	X	X	.	RET .05G
X	X		.	X	X	.	RET 0.2G
			.			.	DRE ±100 nm N66
R	R		/	R	R	/	BANK AN
X	X		.	X	X	.	RETRB
X	X		.	X	X	.	RETBBO
X	X		.	X	X	.	RETEBO
X	X		.	X	X	.	RETDROG +53 SEC TO MAIN

X			-		X			-		AREA
X	X	-		.	X	X	-		.	ΔV TO
X	X	X			X	X	X			R .05G
X	X	X			X	X	X			P .05G
X	X	X			X	X	X			Y .05G
+				.	+				.	RTGO EMS
+					+					V10
X	X		.	.	X	X		.	.	RET .05G
	0		.			0		.		LAT N61
			.					.		LONG
X	X		.	.	X	X		.	.	RET 0.2G
				.					.	DRE (55°) N66
R	R		/		R	R		/		BANK AN
X	X		.	.	X	X		.	.	RETRB
X	X		.	.	X	X		.	.	RETBBO
X	X		.	.	X	X		.	.	RETEBO
X	X		.	.	X	X		.	.	RETDROG
X	X	X			X	X	X			(90°/fps) CHART
X	X				X	X				DRE (90°)UPDATE

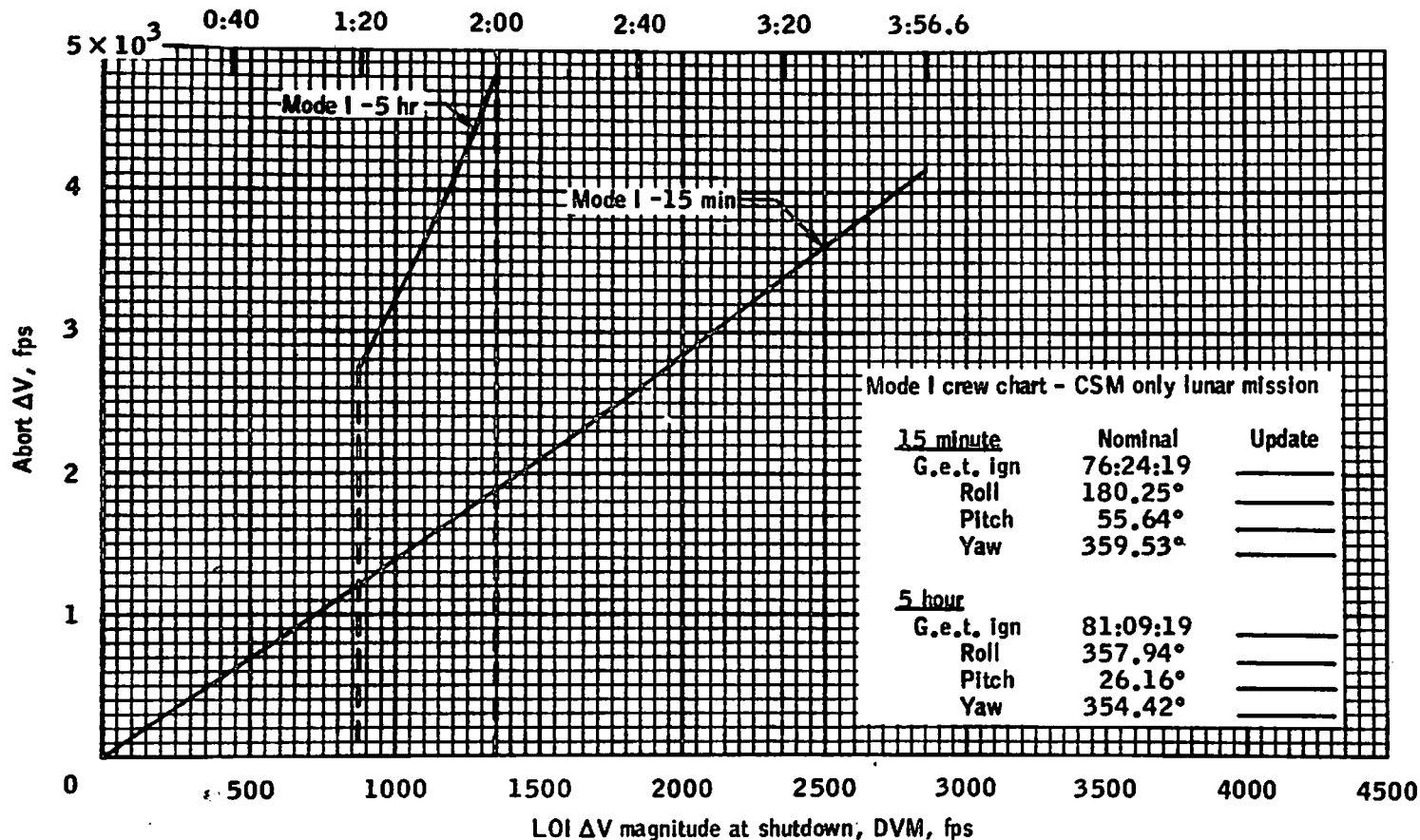
POST BURN

X	X	X			X	X	X			P .05G
+				.	+				.	RTGO EMS
+					+					V10
X	X		.	.	X	X		.	.	RET .05G
X	X		.	.	X	X		.	.	RET 0.2G
				.					.	DRE ±100 nm N66
R	R		/		R	R		/		BANK AN
X	X		.	.	X	X		.	.	RETRB
X	X		.	.	X	X		.	.	RETBBO
X	X		.	.	X	X		.	.	RETEBO
X	X		.	.	X	X		.	.	RETDROG +53 SEC TO MAIN

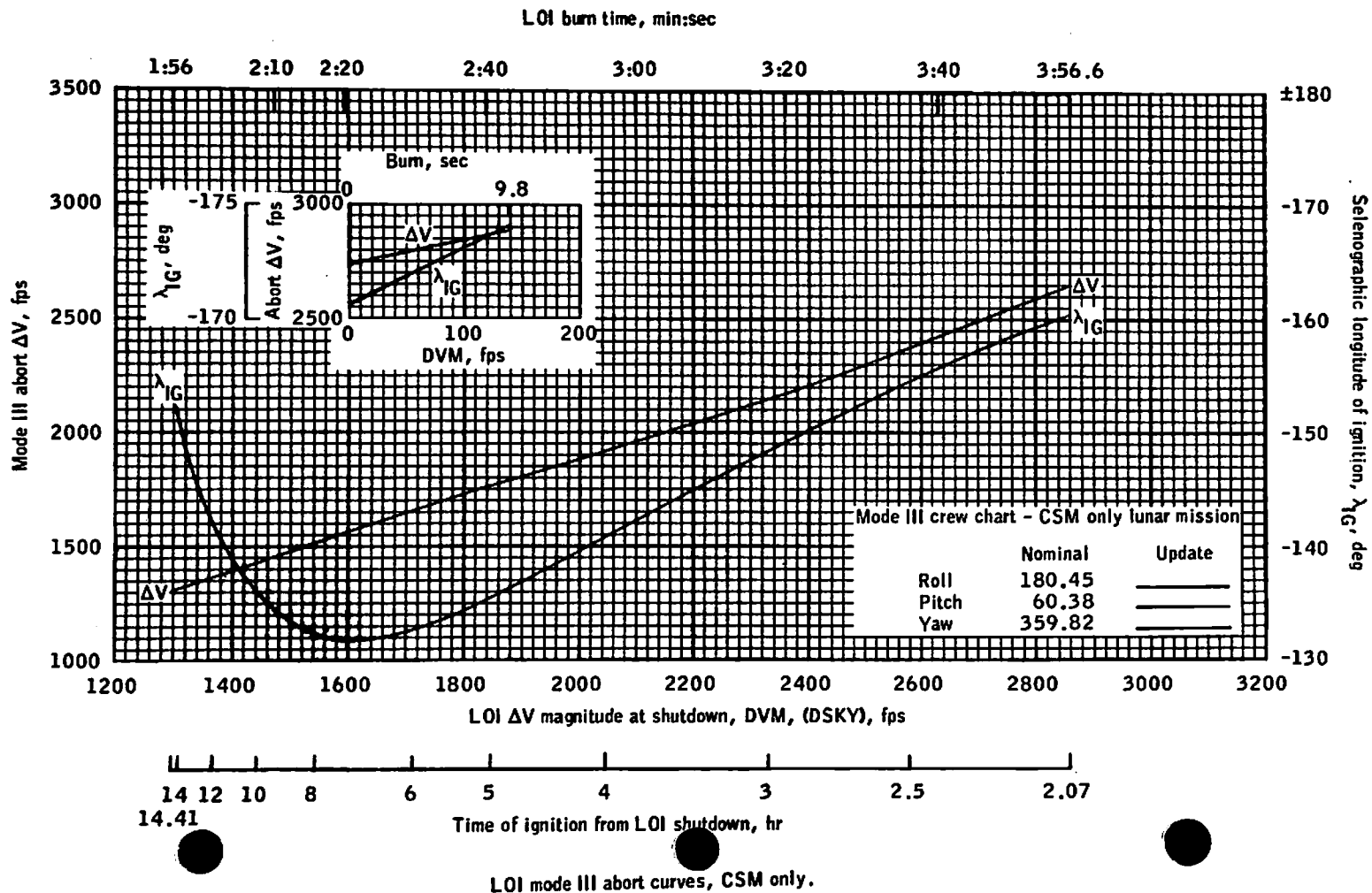
E. O.
ENTRY

Basic Date - MARCH 31, 1969
Changed -

LOI burn time, min:sec

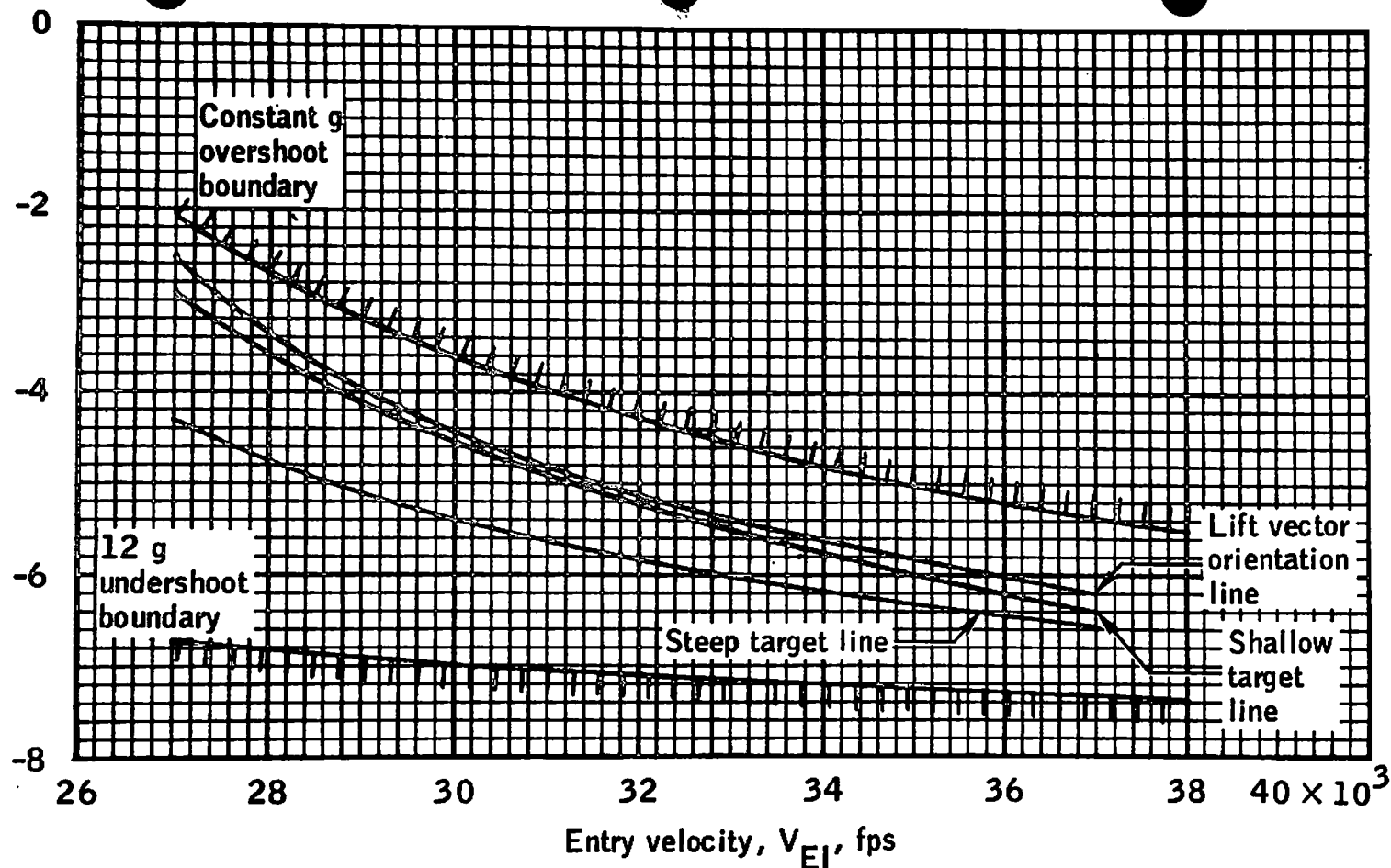


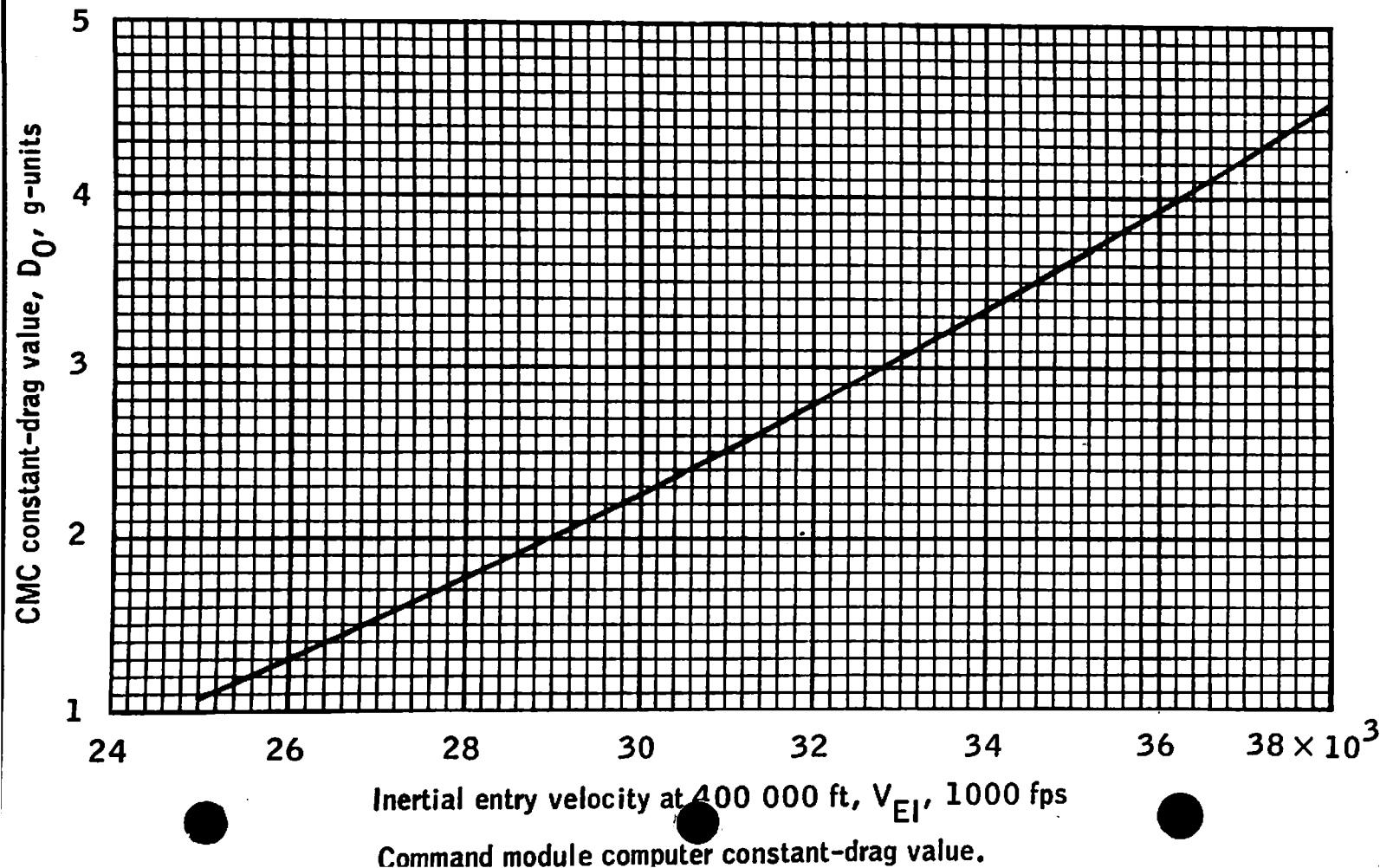
LOI mode I 15 min and 5 hour abort curves, CSM only.

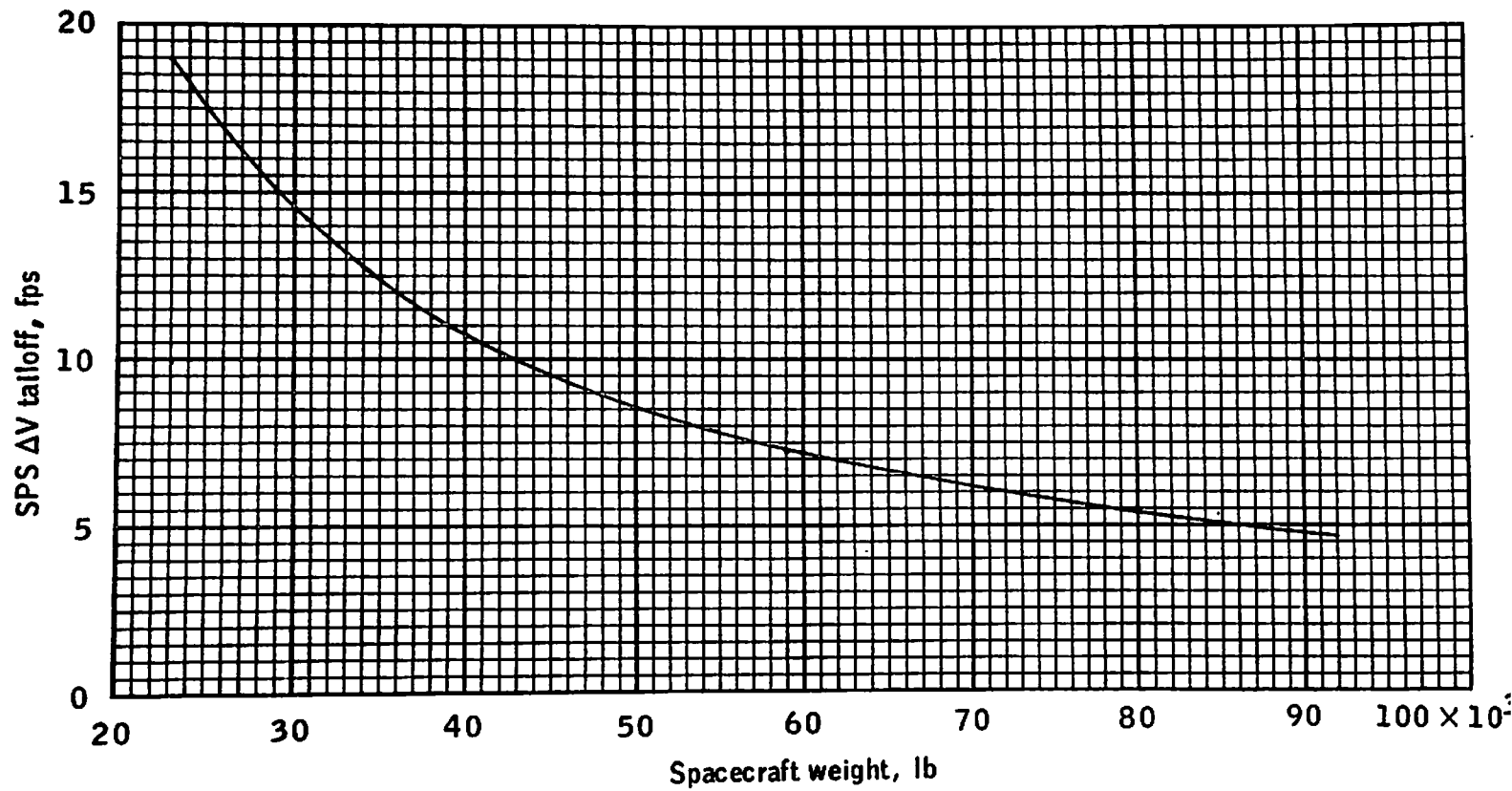


Entry corridor.

Entry flight-path angle, γ_{EI} , deg

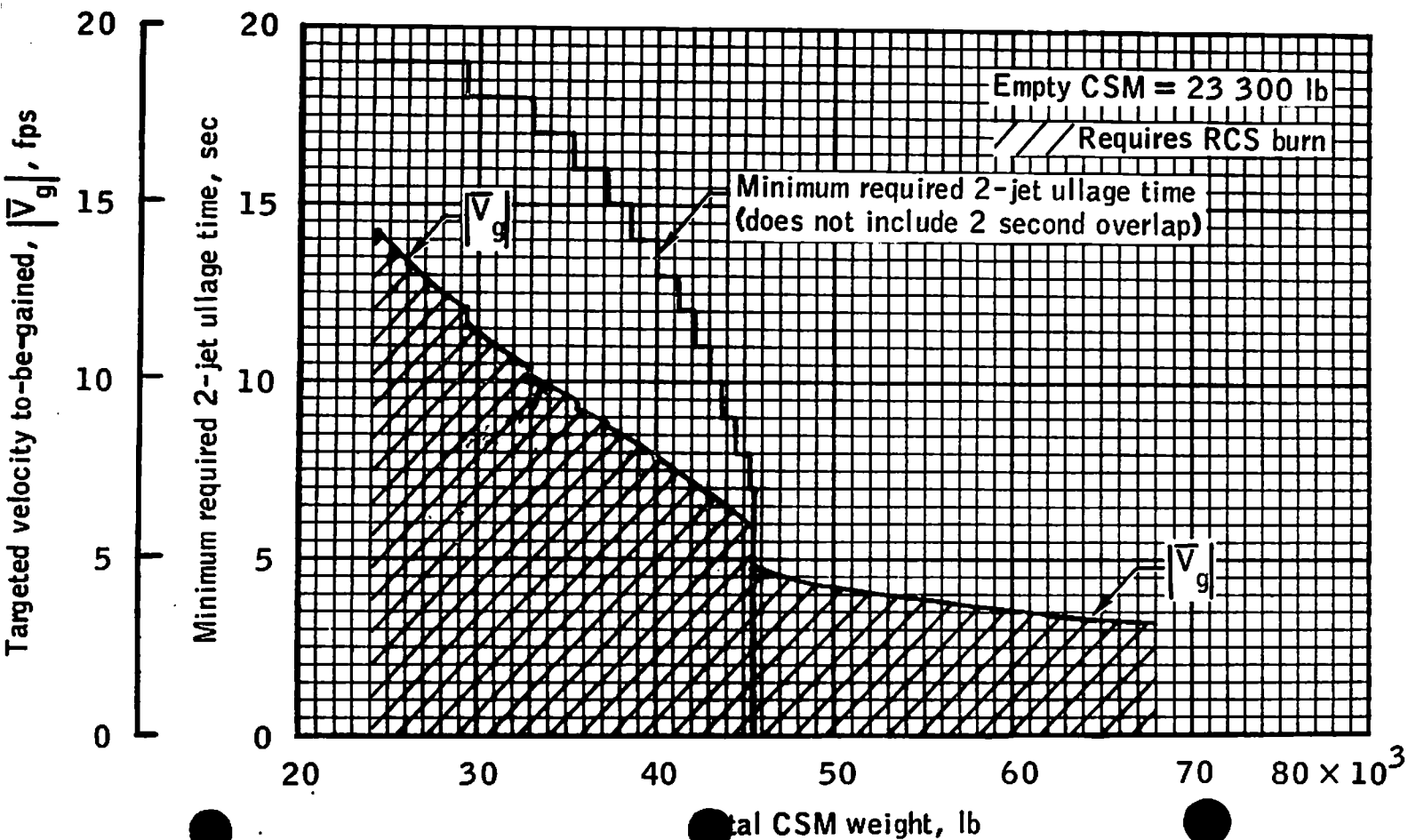






SPS talloff ΔV versus spacecraft weight.

SPS versus RCS criteria, CSM alone



ERASEABLE LOAD UPDATE

IN THE EVENT OF PROG ALARM 1107 PERFORM FOLLOWING

V21N1E 333E 10000E (DUMPCOUNT)

V74E (WAIT 3 MIN) (DUMP E MEMORY)

V36E

V48E (LOAD DAP AS DESIRED - USE

V46E (LATEST KNOWN WEIGHTS)

V25N07E 77E 10000E 1E (SET REFSMMAT)

VIN1E 104E (VERIFY CMOON FLAG AND LMOON FLAG)

(BITS 11 and 12 should be 0 in

EARTH SPHERE AND 1 IN MOON SPHERE)

P52-OPTION 3-AUTO OPTICS

AUTO OPTICS SUCCESSFUL, REFSMMAT
VALID

AUTO OPTICS UNSUCCESSFUL, DO P51

V16 N65 VERIFY CMC CLOCK (UPDATE)

VERIFY E MEMORY (MAY BE USED WHEN DESIRED)

VIN1E

XXXXE (LOAD OID 2 OF UPDATE

N15E, READ R1,E REPEAT FOR UPDATES A-J

FOR UPDATES K and L

VIN1E

1. XXXXE (LOAD EVEN OID'S
2. READ R1,E READ ODD OID'S IN R1)
3. RETURN TO 1

IN CASE OF A DISCREPANCY

LOAD THAT UPDATE AS A NORMAL P27

TO CHECK STATE VECTOR CALL P21

AND LOAD PRESENT TIME. WHEN COMP CYCLE

IS COMPLETE

V06 N73E

READ R1 (R1X 10 =CURRENT ALT (NM)

COMPARE TO SOME KNOWN VALUE (E.G.FLIGHT PLAN)

IF ANSWER COMPARES - STATE VECTOR ARE OK AND

P23 SHOULD BE USED TO IMPROVE IT.

IF GROSS ERRORS ARE OBSERVED, P23 IS UNLIKELY
TO CORRECT THEM.

Basic Date May 8, 1969
Changed

OID	A	B	C	D	E	F
01	V71 00021	V71 00015	V71 00023	V71 00023	V71 00024	V71 00024
02	01452	01706	02000	02021	02042	02064
03	74157		00137	00001	00001	77765
04	76270		00763	03120	07144	40504
05	77011		0023	00001	00027	77436
06	74166	30636	00001	03120	02260	76217
07	77231	33265	00000	00301	77750	77777
10	76540	00000	00000	34760	60503	57747
11	00063	22627	00471	00125	77763	77775
12	77532	00000	00364	04627	53623	76524
13	00231	26314	04400	00002	77733	76754
14	00023	37777	77776	24342	71623	51023
15	00367	37777	72154	00012	77711	01173
16	00321		77764	20425	51407	15143
17	00276		54601	12413	77742	00527
20	00071		00006	00020	44420	31424
21	00205		06537	22472	77636	03054
22			00002	00002	51215	21506
23			31460	03020	77754	03023
24						

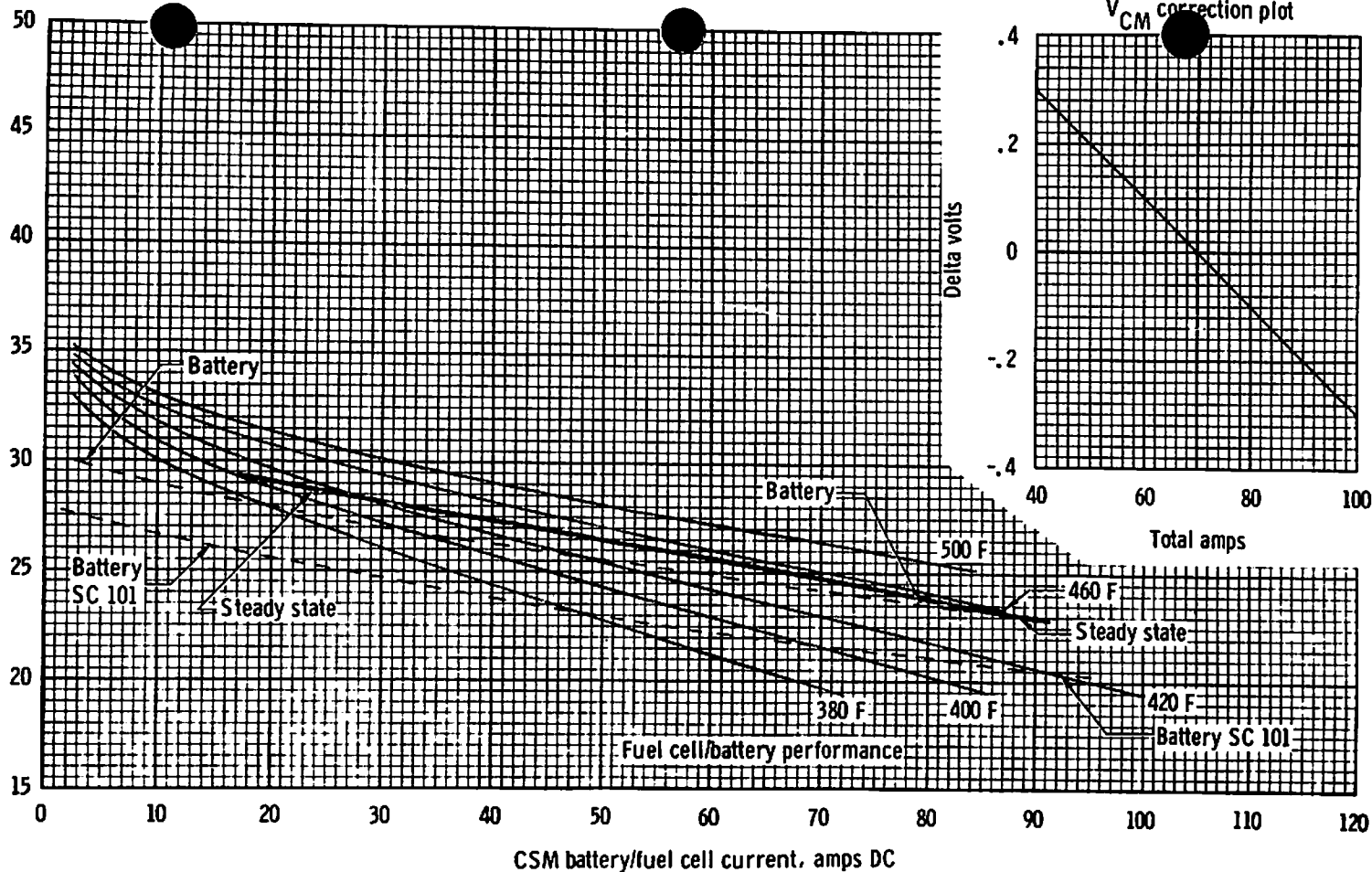
Basic Date 8, 1969

Changed

Basic Date - May 8, 1969
Changed -

OID	G	H	I	J	K	L
01	V71 00024	V71 00022	V71 00024	V71 00021	V72 00023	V72 00023
02	02106	02130	03000	03025	00110	01767
03	01526	01524	00037	37777	01156	00001
04	24331	11341	00245	00000	01341	01770
05	06721	10126	00000	00000	00005	27121
06	23303	14761	00000	54360	01351	01771
07	73437	16256	77777	21075	06510	02174
10	55022	17662	77777	37777	01352	01772
11	75471	06157	77261	60465	07025	37624
12	64166	36207	10510	00000	01353	02377
13	72445	57633	06477	54360	00620	00142
14	42450	51356	74407	21075	01354	03022
15	70653	07761	00101	37777	00000	00232
16	72606	33466	00005	57142	01355	03376
17	74054	03352	00123	33106	27340	01652
20	61243	01225	00175	50741	01356	01773
21	73151	00523	37065	31162	37777	12160
22	51472	25716	02245		01477	01774
23	03061		00156		00000	03363
24	32774		01000			

CM main bus voltage-VDC, 70 amps total



CSM battery/fuel cell current.