APOLLO 15

LM DATA CARD BOOK

PART NO.	S/N
SKB32100115-387	1001

CONTENTS

	Page
LM ACTIVATION	1
LPD CAL/CSM CIRC - PDI RULES/ALT CHECK	2
PDI 0/NO PDI +12	3
PDI 1 ABORT	4
PDI 2 ABORT	5
LUNAR SURFACE	6
ABORT/ASCENT	7
DIRECT TPI	8
CSI	9
CDH/PLANE CHANGE	10
COELLIPTIC TPI	11
P76/77/P27	12
AGS SV/IMPACT	13
P30	14
ASCENT/CSI	15
NOTES	16

#7
25
42

LM ACTIVATION CARD

97 : 54 : 55 PRIM EVAP FLOW TIME

DAP PAD

+						+	3	6	6	3	0	LM WT (+36636) N47
+						+	3	7	6	7	9	CSM WT (+37371)
+						+						GMBL (+00629) N48
+						+						(+00648)

DOCKED P52 ALIGN

						+	0	0	1	7	1	R_1 N93
						−	0	0	2	3	6	R_2
						−	0	0	6	6	3	R_3
		:		:		9	9	: 1	1	: 3	0	GET

37.0 BATT A

37.0 BATT B

98 : 45 : 00 GET

ED BATT VOLTAGE

V06 N20

GET ____ : ____ : ____ (100 : 03 : 56)

LM	R_1							
	R_2							
	R_3							
CSM	R_1							
	R_2							
	R_3							

S-BD

P ____ (+134)
Y ____ (+6)
AOS ____ : ____ : ____ (98 : 24 : 04)

P ____ (+41)
Y ____ (-55)
AOS ____ : ____ : ____ (100 : 17 : 35)

P ____ ( )
Y ____ ( )
AOS ____ : ____ : ____ ( )

UNDOCK/SEP GET 100 : 13 : 5600 (100 : 13 : 56)
P 108

AGS

K FACTOR 100 : 00 : 00006 (100 : 00 : 00)

+							+	6	0	4	4	2	(+60410) 224
+							+	2	9	3	6	5	(+29365) 225
+							+	6	0	4	4	9	(+60423) 226
−							−	0	1	6	5	9	(−01751) 305
−							−	5	5	0	2	1	(−54776) 662
−							−	3	2	3	0	6	(−32014) 673
													(~~+00002~~ −00005) 540
													(~~−00004~~ −00005) 541
													(~~+00003~~ +00000) 542
													(~~+00002~~ −00048) 544
													(~~+00090~~ −00076) 545
													(~~−00007~~ −00036) 546

DATE 6/10/71 7/28/71

PAGE 1

AGS SV/IMPACT P30 | **TPF REL TRAJ NOM COEL RNDZ** | CSI CDH/PLANE CHANGE | ABORT/ASCENT DIRECT TPI | PD12/PD12 ABORT LUNAR SURFACE | PDIO/NO PDI +12 PDI1/PDI1 ABORT | ACTIVATION LPD/CIRC/PDI

LPD CAL/CSM CIRC

LPD ΔBIAS	NEW BIAS = ORIG BIAS(P64)+ΔBIAS(P52) ΔBIAS(AZ) = (LPD RDG) x1.3 ΔBIAS(EL) = (LPD RDG) X1.0							
LPD RDG (P52)								
(+) (-ΔAZ) (-) (-ΔEL)	+	3	5	9	5	4	ORIG BIAS	AZ
							+ΔBIAS(AZ)	
+ + + + 40 + + +							AZ BIAS 3373	
(+) (-) (+) (+)	+	0	0	0	1	8	ORIG BIAS	EL
							+ΔBIAS(EL)	
							EL BIAS 1353	

LOAD NEW BIAS (P64)	VERIFY BIAS
V21 N03E, 3373E LOAD AZ BIAS (.01°) E, 1353E LOAD EL BIAS (.01°)	V06 N03E, 3373E VERIFY AZ BIAS E, 1353E VERIFY EL BIAS

CSM CIRC BURN								
P76								
+	0	0				+ 0 0 1 0 1	HRS (101)	N33
+	0	0	0			+ 0 0 0 3 8	MIN (34)	TIG
+	0			.		+ 0 5 8 . 1 9	SEC (55.10)	
					.	+ 0 0 6 8 3	ΔVX (+70.8)	N84
					.	+ 0 0 0 0 . 1	ΔVY (+0.0)	
					.	+ 0 0 0 0 . 7	ΔVZ (+0.6)	

CSM HA/HP		
CMC	LGC	V82 OPT 2
/	/	

65.2 x 54.8 CSM

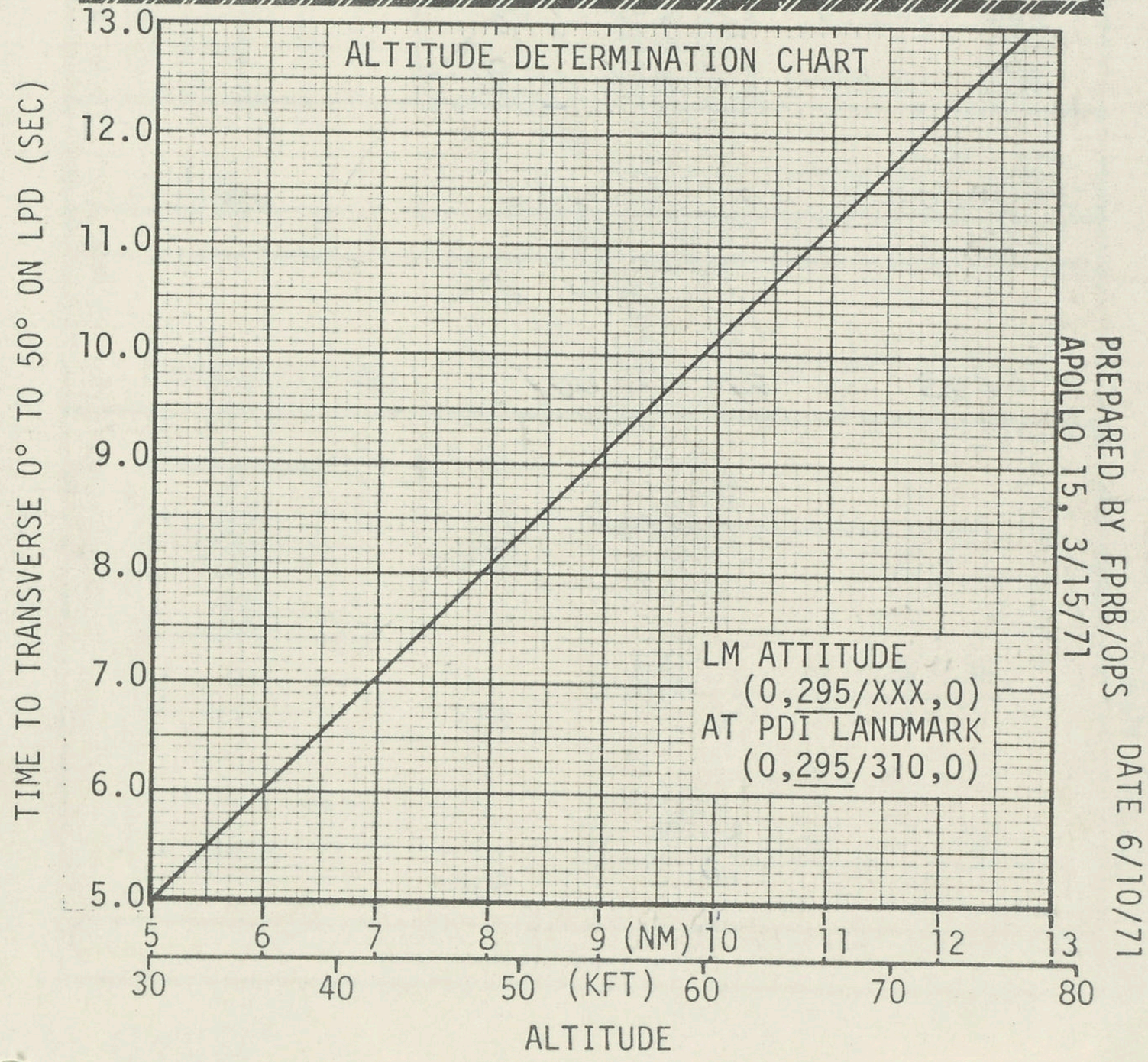
65.2 x 54.6 LM

PDI RULES/ALTITUDE CHECK

PDI RULES

1. NO AUTO ULLAGE - BACKUP VIA +X OVERRIDE (+NO AUTO IGNITION - PDI NO-GO)
2. NO IGN (WITH AUTO ULL) DELAY 2 SEC, THEN START PB-PUSH; THEN DES OVRD - ON AT 5 SEC
3. T/W >1.6 AND DSKY CHANGES >18 fps/2 SEC
4. ATT/RATE <5°/SEC
5. ΔH IN LIMITS >10 SEC, NOT OUT OF LIMITS >60 SEC
6. DATA GOOD AT > 6,000 ft
7. IF NO THROTTLE DOWN BY P64 + 15 SEC - ABORT
8. BINGO FUEL 1 MIN 31 SEC AFTER LOW LEVEL OR WHEN FUEL QTY <2% UNLESS LANDING IMMINENT

NOTE: FOR FLASHING LR ALT OR VEL LIGHTS PRECEDED BY STEADY LR LT, CYCLE RADAR TEST SWITCH



PREPARED BY FPRB/OPS DATE 6/10/71
APOLLO 15, 3/15/71

PDI O/NO PDI + 12 CARD

PDI O ABORT PAD

+	0	0				+	0	0	1	0	2	HRS (102)	N33
+	0	0	0			+	0	0	0	3	9	MIN (34)	TIG
+	0			.		+	0	3	5	. 3	5	SEC (59.20)	A
					.	+	0	1	0	0	. 0	ΔVX (+102.8)	N81
					.	+	0	—	—	—	—	ΔVY (+0.0)	LV
					.	+	0	0	0	1	. 8	ΔVZ (+2.8)	B
+					.	+	0	1	3	8	. 3	HA (+138.9)	N42
					.	+	0	0	0	9	. 0	HP (+8.2)	
+					.	+	0	1	0	0	. 1	ΔVR (+102.8)	
X	X	X		:		X	X	X	0	: 3	4	BT (0:38)	
X	X	X				X	X	X	0	0	0	R (000)	FDAI
X	X	X				X	X	X	2	7	3	P (285)	INER
+					.	+	0	1	5	9	. 6	TIG (155.0)	373
					.	+	0	1	0	0	. 0	ΔVX (+102.8)	N86
					.	+	0	—	—	—	—	ΔVY (+0.0)	AGS
					.	+	0	0	0	2	. 4	ΔVZ (+3.6)	
+	0	0				+	0	0	1	0	3	HRS (103)	N11
+	0	0	0			+	0	0	0	4	0	MIN (35)	CSI
+	0			.		+	0	2	4	. 0	0	SEC (37.90)	C
+	0	0				+	0	0	1	0	5	HRS (105)	N37
+	0	0	0			+	0	0	0	2	2	MIN (21)	TPI
+	0			.		+	0	3	0	. 0	0	SEC (46.50)	D

RESIDUALS

PGNS				AGS			
		.	ΔVX N85			.	ΔVX 500
		.	ΔVY			.	ΔVY 501
		.	ΔVZ			.	ΔVZ 502

NO PDI + 12 ABORT PAD

+	0	0				+	0	0	1	0	4	HRS (104)	N33
+	0	0	0			+	0	0	0	4	2	MIN (40)	TIG
+	0			.		+	0	3	0	. 0	0	SEC (24.70)	E
					.	+	0	1	0	8	. 2	ΔVX (+113.9)	N81
					.	+	0	—	—	—	—	ΔVY (+0.0)	LV
					.	−	0	0	5	0	. 0	ΔVZ (-46.8)	F
+					.	+	0	1	4	4	. 9	HA (+146.6)	N42
					.	+	0	0	0	8	. 6	HP (+8.8)	
+					.	+	0	1	1	9	. 2	ΔVR (+123.1)	
X	X	X		:		X	X	X	0	: 3	6	BT (0:40)	
X	X	X				X	X	X	0	0	0	R (000)	FDAI
X	X	X				X	X	X	2	7	0	P (271)	INER
+					.	+	0	2	8	2	. 5	TIG (280.4)	373
					.	+	0	1	0	8	. 5	ΔVX (+114.3)	N86
					.	+	0	—	—	—	—	ΔVY (+0.0)	AGS
					.	−	0	0	4	9	. 3	ΔVZ (-45.9)	
+	0	0				+	0	0	1	0	7	HRS (107)	N11
+	0	0	0			+	0	0	0	3	7	MIN (35)	CSI
+	0			.		+	0	3	0	. 0	0	SEC (38.90)	G
+	0	0				+	0	0	1	0	9	HRS (109)	N37
+	0	0	0			+	0	0	0	1	8	MIN (18)	TPI
+	0			.		+	0	4	5	. 0	0	SEC (38.30)	H

RESIDUALS

PGNS				AGS			
		.	ΔVX N85			.	ΔVX 500
		.	ΔVY			.	ΔVY 501
		.	ΔVZ			.	ΔVZ 502

DATE 6/10/71

PDI 1 ABORT CARD

PDI 1 PAD

+	0	0	1	0	4	+	0	0	~~X~~ 0	~~4~~		HRS(104)	N33
+	0	0	0	3	0	+	0	0	0	~~3~~ 0		MIN(28)	PDI
+	0	0	8	5	4	+	0	1	~~.~~ 0	~~9~~ 9	~~4~~	SEC(54.82)	
X	X					X	X	1	1	0	3	TGO(11:04)	N61
~~+~~	0	0	0	3	3	~~+~~	~~0~~	~~0~~	~~2~~ 0	~~9~~ 2		X RANGE(+0.0)	
X	X	X				X	X	X	0	0	2	R (000)	FDAI
X	X	X				X	X	X	1	1	0	P (111)	AT TIG
X	X	X				X	X	X	3	1	0	Y (310)	
~~+~~	5	6	9	4	3	~~+~~	~~5~~	~~6~~	~~9~~	~~2~~	~~2~~	DEDA 231 IF ROD	

#04

-01600

(0<PDI 1< 6:10) ABORT PAD EARLY

LOG INSERTION GET= ___ ___ ___:___ ___:___ ___
+ 1 0 0 0 0

BOOST GET= ___ ___ ___:___ ___:___ ___
+ 1 0 0 0 0

HAM GET= ___ ___ ___:___ ___:___ ___
+ 1 0 0 0 0

CSI GET= ___ ___ ___:___ ___:___ ___

+	0	0				+	0	0	1	0	9	HRS(109)	N37
+	0	0	0			+	0	0	0	1	8	MIN(18)	TPI
+	0			.		+	0	4	5	.	0	SEC(38.30)	J

T1-1(6:10 ≤ PDI 1 ≤ 15) ABORT PAD LATE

LOG INSERTION GET= ___ ___ ___:___ ___:___ ___
+ 5 5 0 0

CSI GET= ___ ___ ___:___ ___:___ ___

+	0	0				+	0	0	1	0	7	HRS(107)	N37
+	0	0	0			+	0	0	0	2	0	MIN(20)	TPI
+	0			.		+	0	3	0	.	0	SEC(12.50)	K

T2-1(PDI 1 + 21 : 26___ : ___) ABORT PAD

LOG INSERTION GET= ___ ___ ___:___ ___:___ ___

BOOST GET= ___ ___ ___:5 0 :0 0

HAM GET= ___ ___ ___:1 0 0 :0 0

CSI GET= ___ ___ ___:5 0 :0 0

+	0	0				+	0	0	1	0	4	HRS(104)	N33
+	0	0	0			+	0	0	0	5	0	MIN(50)	TIG
+	0			.		+	0	4	9	.	6	SEC(20.80)	L
+	0	0				+	0	0	1	0	9	HRS(109)	N37
+	0	0	0			+	0	0	0	1	8	MIN(18)	TPI
+	0			.		+	0	4	5	.	0	SEC(38.30)	M

N69 TARGET UPDATE

	ΔDN RNG
	ΔX RNG V25
	ΔRLS
	ΔDN RNG V21
	ΔDN RNG
	ΔX RNG V24
	ΔRLS V23

THROTTLE DOWN ___:___

F2 2039
~~2299~~

T3-1 (1 REV) ABORT TIME

+	0	0				+	0	0	1	0	6	HRS(106)	N33
+	0	0	0			+	0	0	0	4	1	MIN(40)	TIG
+	0			.		+	0	2	0	.	0	5 SEC(58.40).	N

PAGE 4

DATE 6/10/71

PDI 2 ABORT CARD

PDI 2 PAD

+	0	0				+	0	0				HRS(106)	N33
+	0	0	0			+	0	0	0			MIN(22)	PDI
+	0			•		+	0			•		SEC(34.00)	I
X	X			•		X	X			•		TGO(11:04)	N61
					•						•	X RANGE(+0.0)	
X	X	X				X	X	X				R (000)	FDAI
X	X	X				X	X	X				P (111)	AT TIG
X	X	X				X	X	X				Y (310)	
		.										DEDA 231 IF RQD	

(0<PDI 2 < 9:16) ABORT PAD EARLY

LOG INSERTION GET= ___ ___ ___:___ ___:___ ___
+ 1 0 0 0 0
BOOST GET= ___ ___ ___:___ ___:___ ___
+ 1 0 0 0 0
HAM GET= ___ ___ ___:___ ___:___ ___
+ 1 0 0 0 0
CSI GET= ___ ___ ___:___ ___:___ ___

+	0	0				+	0	0				HRS(111)	N37
+	0	0	0			+	0	0	0			MIN(17)	TPI
+	0			•		+	0	0		•		SEC(04.20)	J

T1-2(9:16 ≤ PDI 2 ≤ 15) ABORT PAD LATE

LOG INSERTION GET= ___ ___ ___:___ ___:___ ___
+ 5 5 0 0
CSI TIG ___ ___ ___:___ ___:___ ___

+	0	0				+	0	0				HRS(109)	N37
+	0	0	0			+	0	0	0			MIN(18)	TPI
+	0			•		+	0			•		SEC(38.30)	K

T2-2(PDI 2 +19:40 :) ABORT PAD

LOG INSERTION GET= ___ ___ ___:___ ___:___ ___
+ 5 0 0 0
CSI GET= ___ ___ ___:___ ___:___ ___

+	0	0				+	0	0				HRS(106)	N33
+	0	0	0			+	0	0	0			MIN(42)	TIG
+	0			•		+	0			•		SEC(14.10)	L
+	0	0				+	0	0				HRS(109)	N37
+	0	0	0			+	0	0	0			MIN(18)	TPI
+	0			•		+	0			•		SEC(38.30)	M

N69 TARGET UPDATE

						ΔDN RNG
						ΔX RNG V25
						ΔRLS
						ΔDN RNG V21
						ΔDN RNG
						ΔX RNG V24
						ΔRLS V23

THROTTLE DOWN ___:___

T3-2 (1 REV) ABORT TIME

+	0	0				+	0	0				HRS (108)	N33
+	0	0	0			+	0	0	0			MIN (39)	TIG
+	0			•		+	0			•		SEC (10.00)	N

DATE 6/10/71

PAGE 5

LUNAR SURFACE CARD

FIRST REV ACTIVITY

LAUNCH PREP

N20
34267 OG 00702 IG 35143 MG

P57, A/T 1, REFSMMAT
N04 + 04, + 01 NAV ERR
N05 - 03
N93 - 011 X - 041 Y - 002 Z

P57, A/T 2, REFSMMAT
STAR1 303 (N71)
STAR2 612 (N71)

N05 + 01 ANGLE DIFF
N93 - 075 X
+ 058 Y
- 060 Z
N89 + 26167 LAT
+ 01779 LONG/2
+ 0 — ALT

P57, A/T 2, REFSMMAT
STAR1 6 61 (N71)
STAR2 3 122 (N71)
N05 - 00 ANGLE DIFF
N93 - 08 X
- 21 Y
- 33 Z
N89 + 26191 LAT
+ 01812 LONG/2
± 0000 ALT

N88 + 10975
61 + 99373
- 02127

122 + 54566
+ 09353
+ 83277

N43
LAT(+N) + 2612
LONG(+E) + .370
ALT ____.__

047 + 36416 053 + 11461

544 + 00021 +5:02 + 00014
545 + 00081 + 00081
546 - 00015 - 00006

047 + 36451 053 + 11331

P57, A/T 3, LANDING SITE
N04 _____, _____ GRAV ERR
STAR _____ (N71)
N05 _____ ANGLE DIFF
N93 _____ X
_____ Y
_____ Z

5 MK 5 03
182.2 284.0

P57, A/T 3, LANDING SITE
N04 _____, _____ GRAV ERR
STAR _____ (N71)
N05 _____ ANGLE DIFF
N93 _____ X
_____ Y
_____ Z

P22 ACQ _____:_____:_____

REV 48 TIG _____:_____:_____
(171: 37 : 24)

544 _____ +5:02 _____
545 _____ _____
546 _____ _____
377 _____

K FACTOR _____:_____:_____
(170 : 00 : 00)

047 _____
053 _____

LIFT-OFF TABLE

NOMINAL = (M=2) | (M=1) ~ (M=2) -2:30

REV	NEW TIG	NOM TIG	REV	NEW TIG	NOM TIG
16	108 39 45	108:39:10	32	140 10 24	140:09:26
17	110 38 00	110:37:19	33	142 08 33	142:07:34
18	112 36 13	112:35:28	34	144 06 46	144:05:43
19	114 34 26	114:33:36	35	146 05 03	146:03:51
20	116 32 39	116:31:45	36	148 02 57	148:01:59
21	118 30 48	118:29:53	37	150 01 04	150:00:07
22	120 29 06	120:28:02	38	151 58 58	151:58:15
23	122 27 10	122:26:10	39	153 57 03	153:56:23
24	124 25 21	124:24:19	40	155 55 07	155:54:31
25	126 23 32	126:22:27	41	157 53 14	157:52:39
26	128 21 44	128:20:36	42		159:50:46
27	130 19 54	130:18:44	43	161 49 31	161:48:54
28	132 17 54	132:16:53	44	163 47 36	163:47:02
29	134 16 02	134:15:01	45	165 45 40	165:45:23
30	136 14 10	136:13:09	46	167 43 49	167:43:32
31	138 12 19	138:11:18	47	169 41 53	169:41:40

+ 180
H.G. + 270
+ 71
- 58

105 20
1800 - FRIDAY
LOCATION
BR 3 75.5

PAGE 6

DATE 6/10/71

V21 N01
1459 E
04366

X P
V21 N01
1452 E
04672

41.3
X
9.1

171 37 2236

ABORT/ASCENT CARD

DATE 7/16/71 ~~6/10/71~~

ASCENT RULES

UNDERBURN

ΔV(FPS)	TIME(SEC)	PGNS	AGS
<400	<20	NULL RESIDUALS	AUTO,A/H 15fps
>400	>20	A/H BURN HA,HP Ḣ CONTROL	AUTO,A/H 15fps

INSERTION

WITH VOICE-GROUND RECOMMENDS TRIM SOURCE AT T_{GO}=1 MIN

- DIRECT ASCENT RNDZ
  TRIM TO <2 FPS AND STANDBY FOR TWEAK AT INSERTION ATTITUDE
- COELLIPTIC RNDZ
  TRIM TO <2 FPS (AGS X-AXIS ONLY) AND STANDBY FOR TWEAK (10° OHW OR 250° FDAI)
- TWEAK AT INSERTION PLUS 2 MINUTES

FOR NO VOICE

PGNS, AGS DIFFER <10FPS, TRIM ACTIVE SYSTEM
PGNS, AGS DIFFER >10FPS, TRIM SYSTEM WHICH AGREES WITH RR

ATT/RATE ERROR >10°/SEC

T3 (1 REV) ABORT PAD

LOG INSERTION GET= ___ ___ ___:___ ___:___ ___
+ 5 0 0 0
CSI TIG= ___ ___ ___:___ ___:___ ___
+ 1 3 3 0 0
TPI TIG= ___ ___ ___:___ ___:___ ___

			HRS (106) N33
+ 0 0	+ 0 0		
+ 0 0 0	+ 0 0 0		MIN (40) TIG
+ 0 .	+ 0 .		SEC (58.40) N

ONE REV LATE ___:___:___
(173 : 38 : 06)

LM ASCENT PAD

+ 0 0 / / /	+ 0 0 1 7 1	+ 0 0 1 7 1	HRS (171) N33
+ 0 0 0	+ 0 0 0 4 0	+ 0 0 0 3 7	MIN (37) TIG
+ 0 .	+ 0 1 3 4 1	+ 0 2 2 3 6	SEC (23.87)
+ .	+ 5 5 3 2 0	+ 5 5 3 0 4	V(X)(5536.4)
+ .	+ 0 0 2 0 0	+ 0 0 3 2 0	V(H)(32.0)N76
0 .	− 0 0 0 0 5	− 0 0 0 0 4	X RANGE(+0.0)
	+ 3 7 7 4 2	+ 3 7 7 4 2	047 (+40000)
	+ 0 1 7 2 2	+ 0 1 7 2 2	053 (+00000)
	+ 5 8 5 5 0	+ 5 8 5 1 6	224/226(+58566)
	+ 5 6 9 4 3	+ 5 6 9 4 3	231 (+56907)
.	+ 0 0 2 0 0	+ 0 0 3 2 0	465 (+32.0)
.	NA .	+ 0 1 4 9 6	373 (+149.7)
+ 0 0	+ 0 0	+ 0 0 1 7 2	HRS (172) N37
+ 0 0 0	+ 0 0 0	+ 0 0 0 2 9	MIN (29) TPI
+ 0 .	+ 0 .	+ 0 3 9 0 0	SEC (39.10)
+	+	+ 1 0 9 3 6	LM WT (10873)

*NOTE: LOAD 8 NM CROSSRANGE IF GREATER THAN 8 NM

+	HA V82	+ HA 315
+	HP	+ HP 403

RESIDUALS

PGNS		AGS	
ΔVX	N85	ΔVX	500
ΔVY		ΔVY	501
ΔVZ		ΔVZ	502

173 35 34

PAGE 7

DIRECT TPI CARD

BURN RULES

IF TWO OF THREE SOLUTIONS AGREE,
BURN PRIORITY SOLUTION.

PRIORITY OF SOLUTION: PGNS, AGS, CMC, CHARTS.
GUIDE VALUES: $\dot{X}$=3 fps, $\dot{Y}$=7 fps, $\dot{Z}$=9 fps

RR AGREES WITH VHF.WHERE
$\Delta R = 0.01R + 0.5$ NM, ΔR IS ALWAYS $\geq$ 1 NM
RR DOES NOT AGREE WITH VHF,
MSFN ISOLATES FAILED SYSTEM.

APS ENGINE FOR $\Delta V > 40$fps

TPI SOLUTIONS

		PGNS	AGS	CMC	CHARTS
TIG		N37	373	N37	149.6
θ LOS	(+26.6)	N55 31.1	303 37.67	N55	15.
HP	(+43.9)	N58 +38.5	402 +35.1	N58	164.6
ΔV TPI	(+73.6)	+72.9	370 74.6		15
ΔV TPF	(+31.7)	+28.6	371 25.6		179.6
ΔVX		N81 +70.6	450 +67.5	N81* -69.4	ΔVX
ΔVY		+5.9	451 -6.4	* -6.2	
ΔVZ		-16.9	452 -30.4	* +12.0	ΔVZ

** IF ΔV TPF >55 fps, SEE TPI 2 BELOW:

*CHANGE SIGN
BIAS; ΔVX = -1.0
ΔVZ = +2.0

TIG	V21 N01	N37	373	N37
θ LOS	1452	N55 32°	303	N55
HP	05210	N58 38.3	402	N58
ΔV TPI		72.8	370 73.1	
ΔV TPF	1456	25.4	371 25.4	
ΔVX	63170	N81 +70.3	450 +70.4	N81* -69.1 ΔVX
ΔVY		+5.9	451 +5.9	* -6.1
ΔVZ		-17.7	452 -19.1	* +16.1 ΔVZ

TPI PAD

+	0	0				+	0	0				HRS(172) N37
+	0	0	0			+	0	0	0			MIN(29) TPI
+	0			.		+	0			.		SEC(39.10)
R1(+00000), R2(+000.00), R3(+130.00)												N55
	0				.		0		6	6	.3	ΔVX(+70.6) N81
	0				.	+	0			7	.8	ΔVY(-0.5) LV
-	0		1	9	.0	-	0		3	1	.2	ΔVZ(+21.0)
+	0				.	+	0				.	R(+37.35) N54
-	0				.	-	0				.	Ṙ(-113.0) TPI TIG-5
X	X				.	X	X				.	BT(00:03)

RESIDUALS

PGNS					AGS			
+		2	ΔVX	N85			ΔVX	500
+		2	ΔVY				ΔVY	501
-		4	ΔVZ				ΔVZ	502

DATE ~~6/10/71~~ 7/16/71

TPI 2

PGNS

P34
TPI 2 = TPI + 37 min
N55 (Wt) = ΔVTPF/2
V67 (+02000, +00020, +00005)

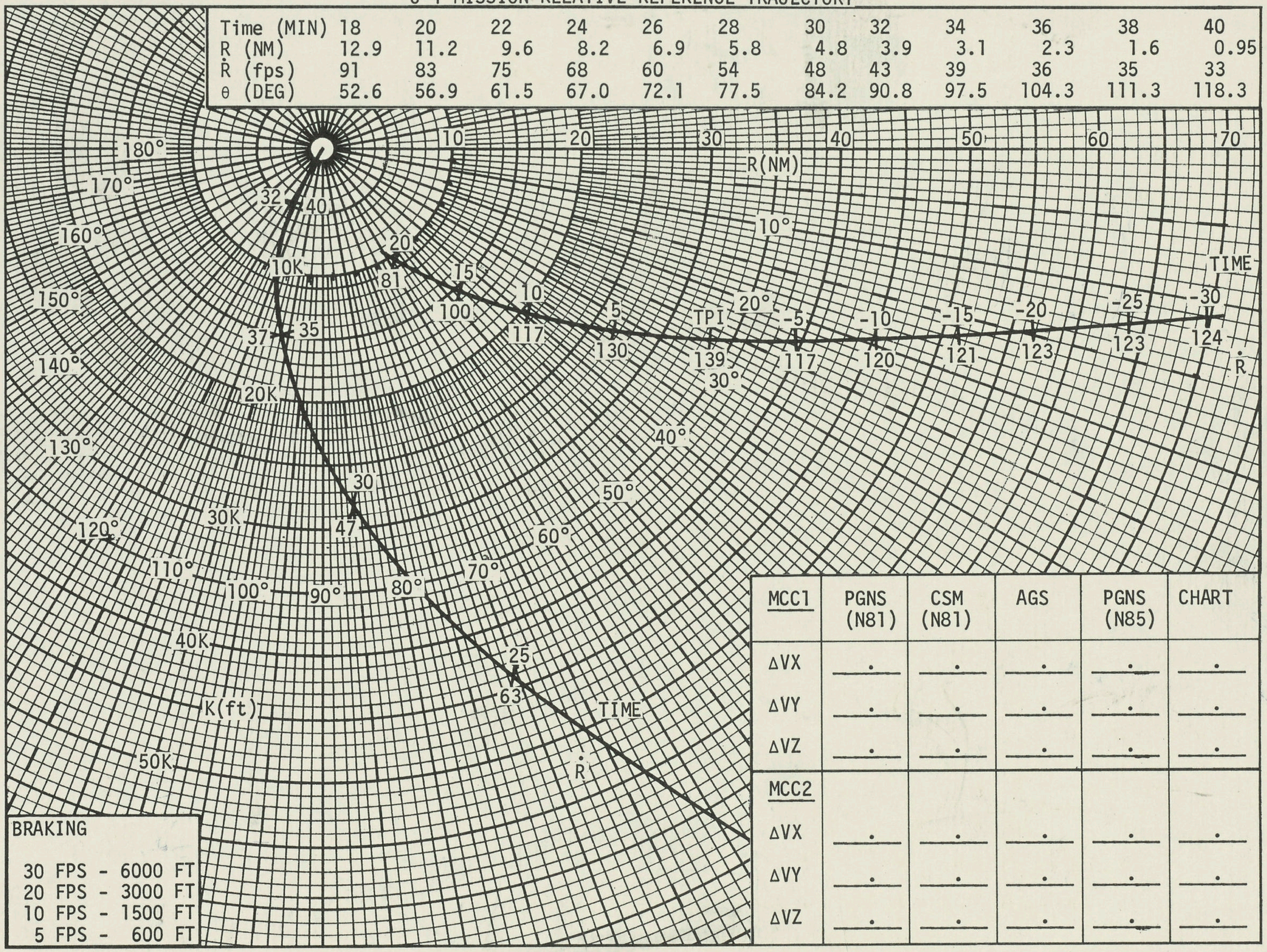
73.7 26.0 TPF

AGS

410 + 4
373 = TPI + 37 min
307 + (ΔVTPF/6)
DELAY 5 min:
417 +1
411 +1

J-1 MISSION RELATIVE REFERENCE TRAJECTORY

Time (MIN)	18	20	22	24	26	28	30	32	34	36	38	40
R (NM)	12.9	11.2	9.6	8.2	6.9	5.8	4.8	3.9	3.1	2.3	1.6	0.95
$\dot{R}$ (fps)	91	83	75	68	60	54	48	43	39	36	35	33
θ (DEG)	52.6	56.9	61.5	67.0	72.1	77.5	84.2	90.8	97.5	104.3	111.3	118.3



BRAKING

30 FPS - 6000 FT
20 FPS - 3000 FT
10 FPS - 1500 FT
5 FPS - 600 FT

MCC1	PGNS (N81)	CSM (N81)	AGS	PGNS (N85)	CHART
ΔVX	____.	____.	____.	____.	____.
ΔVY	____.	____.	____.	____.	____.
ΔVZ	____.	____.	____.	____.	____.
MCC2					
ΔVX	____.	____.	____.	____.	____.
ΔVY	____.	____.	____.	____.	____.
ΔVZ	____.	____.	____.	____.	____.

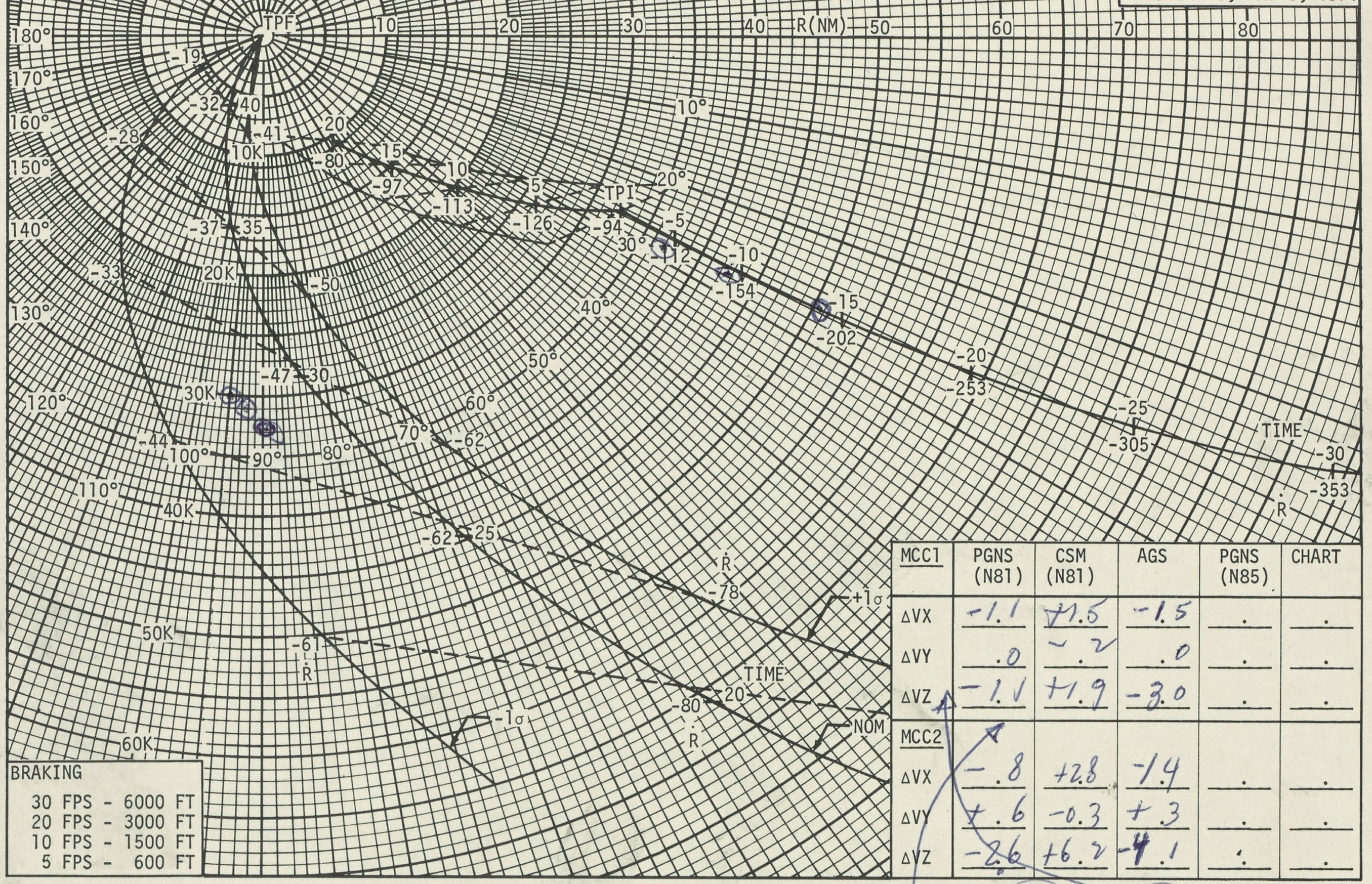
Prepared by FPRB/OPS
MISSION APOLLO 15, MAY 3, 1971

REL TRAJ DIRECT ASCENT | ABORT/ASCENT DIRECT TPI | PDI2/PDI2 ABORT LUNAR SURFACE | PDI0/NO PDI +12 PDI1/PDI1 ABORT | ACTIVATION LPD/CIRC/PDI

J-1 MISSION RELATIVE REFERENCE TRAJECTORY

Time (MIN)	18	20	22	24	26	28	30	32	34	36	38	40
R (NM)	12.56	10.91	9.40	8.03	6.80	5.70	4.72	3.84	3.05	2.53	1.64	.99
Ṙ (fps)	87.27	80.02	72.77	65.67	58.90	52.62	47.02	42.23	38.36	35.45	33.47	32.32
θ (DEG)	52.27	56.47	61.03	65.99	71.34	77.09	83.18	89.57	96.16	102.84	109.50	116.03

PREPARED BY FPRB/OPS
MISSION 15, MAY 3, 1971



BRAKING
30 FPS - 6000 FT
20 FPS - 3000 FT
10 FPS - 1500 FT
5 FPS - 600 FT

MCC1	PGNS (N81)	CSM (N81)	AGS	PGNS (N85)	CHART
ΔVX	-1.1	+1.5	-1.5	.	.
ΔVY	.0	-.2	.0	.	.
ΔVZ	-1.1	+1.9	-3.0	.	.
MCC2					
ΔVX	-.8	+2.8	-1.4	.	.
ΔVY	+.6	-0.3	+.3	.	.
ΔVZ	-2.6	+6.2	-4.1	.	.

Res. .0 .1 .2

+ 18 - 7
- 1 15 - 14
0 1 MCC 2

DATE 5/14/71

CSI CARD

DATE 6/10/71

BURN RULES

IF TWO OF THREE SOLUTIONS AGREE
BURN PRIORITY SOLUTION.

PRIORITY OF SOLUTIONS: PGNS, AGS, CMC, CHARTS.

GUIDE VALUE: $\dot{X}$ = 3 fps.

RR AGREES WITH VHF WHERE
$\Delta R = 0.01R + 0.5$ NM, ΔR IS ALWAYS $\geq$ 1 NM
RR DOES NOT AGREE WITH VHF,
MSFN ISOLATES FAILED SYSTEM.

V90 < 5 fps - NO BURN

APS ENGINE FOR ΔV>40fps

CSI PAD

+	0	0				+	0	0	1	7	2	HRS(172) N11
+	0	0	0			+	0	0	0	3	5	MIN(36) CSI
+	0			.		+	0	0	8	. 0	0	SEC(50.50)
R1(+00001),R2(+026.60),R3(+130.00)												N55
+	0	0				+	0	0	1	7	4	HRS(174) N37
+	0	0	0			+	0	0	0	2	7	MIN(29) TPI
+	0			.		+	0	0	.			SEC(02.88)
	0				.	+	0	0	4	9	. 0	ΔVX(+50.4)N81
	0				.	+	0				.	ΔVY(+0.0)LV
410+1, 605+00777, 416+1, 623+0												
+					.	+	0	1	5	5	. 1	373(156.9)
+					.	+	0	2	6	7	. 0	275(269.0)
	0				.	+	0	0	4	9	. 0	ΔVX(+50.4)N86
	0				.	+	0				.	ΔVY(+0.0)AGS
	0				.	+	0	0	0	1	. 1	ΔVZ(+1.1)

CSI SOLUTIONS

	PGNS	AGS	CMC	CHARTS
ΔH (+15.0)	N75_____	402_____		
CSI/CDH(58:18)	_____	372_____		
CDH/TPI(53:54)	_____			
ΔVX (ΔVG)	N81_____	370_____	N81*_____	ΔV_____
ΔVY	_____	263_____	*_____	
CDH ΔVX(0.0)	N82_____			
CDH ΔVZ(0.0)	_____			

*CHANGE SIGN
BIAS; ΔVX = -1.0

ΔH	N75_____	402_____		
CSI/CDH	_____	372_____		
CDH/TPI	_____			
ΔVX (ΔVG)	N81_____	370_____	N81*_____	ΔV_____
ΔVY	_____	263_____	*_____	
CDH ΔVX	N82_____			
CDH ΔVZ	_____			

RESIDUALS

PGNS		AGS	
ΔVX	N85	ΔVX	500
ΔVY		ΔVY	501
ΔVZ		ΔVZ	502

PAGE 9

IF TWO OF THREE SOLUTIONS AGREE, BURN PRIORITY SOLUTION.
PRIORITY OF SOLUTION: PGNS, AGS, CMC, CHARTS.
GUIDE VALUES: $\dot{X}$=3fps, $\dot{Z}$=9 fps
RR AGREES WITH VHF WHERE ΔR=0.01 + 0.5 NM, ΔR IS ALWAYS $\geq$1 NM
RR DOES NOT AGREE WITH VHF, MSFN ISOLATES FAILED SYSTEM.
V90 < 5 fps - NO BURN

+	0	0				+	0	0				HRS(173) N13
+	0	0	0			+	0	0	0			MIN(35) CDH
+	0			.		+	0			.		SEC(08.50)
	0			.			0			.		ΔVX(+0.0) N81
	0			.			0			.		ΔVY(+0.0) LV
	0			.			0			.		ΔVZ(+0.0)
X	X	X				X	X	X				PLM FDAI
+						+						373(215.1)
	0						0					ΔVX(+0.0) N86
	0						0					ΔVY(+0.0) AGS
	0						0					ΔVZ(+0.0)

PLANE CHANGE P30

TIG CDH ___ ___ ___:___ ___:___ ___.___ ___
− 3 0 : 0 0 . 0 0

TIG PC ___ ___ ___:___ ___:___ ___.___ ___

YDOT AND Y

CSM(N90)		PGNS(N90)		AGS(270)	
YDOT	Y	YDOT	Y	YDOT	
(-)___.___	___.___	(-)___.___	___.___	( )___.___	___.___
(-)___.___	___.___	(-)___.___	___.___	( )___.___	___.___

CDH/PLANE CHANGE CARD

CDH SOLUTIONS

		PGNS	AGS	CMC	CHARTS
ΔH	(+14.9)	N75 ___	402 ___		
CDH/TPI	(53:54)	___			
ΔT SLIP	(00:00)	___			
ΔVX		N81 ___	450 ___	N81* ___	ΔVX ___
ΔVY		___	263 ___	* ___	
ΔVZ		___	452 ___	* ___	ΔVY ___

*CHANGE SIGN NO BIAS

ΔH		N75 ___	402 ___		
CDH/TPI		___			
ΔT SLIP		___			
ΔVX		N81 ___	450 ___	N81* ___	ΔVX ___
ΔVY		___	263 ___	* ___	
ΔVZ		___	452 ___	* ___	ΔVY ___

RESIDUALS

PGNS		AGS	
ΔVX	N85	ΔVX	500
ΔVY		ΔVY	501
ΔVZ		ΔVZ	502

DATE 6/10/71

COELLIPTIC TPI CARD

DATE 6/10/71

BURN RULES

IF TWO OF THREE SOLUTIONS AGREE,
BURN PRIORITY SOLUTION.

PRIORITY OF SOLUTIONS: PGNS, AGS, CMC, CHARTS.
GUIDE VALUES: $\dot{X}$=3 fps, $\dot{Y}$=7 fps, $\dot{Z}$=9 fps

RR AGREES WITH VHF WHERE
$\Delta R = 0.01R + 0.5$ NM, ΔR IS ALWAYS $\geq$ 1 NM
RR DOES NOT AGREE WITH VHF,
MSFN ISOLATES FAILED SYSTEM.

IF TIG TPI > 8 min EARLY - RECYCLE P34
WITH TIG EQUAL TO NOMINAL TIG-8 min

APS ENGINE FOR ΔV > 40 fps

TPI SOLUTIONS

		PGNS	AGS	CMC	CHARTS
TIG	N37	_____	373 _____	N37 _____	
θ LOS	(+26.6) N55	_____	303 _____	N55 _____	
HP	(+44.1) N58	_____	402 _____	N58 _____	
ΔV TPI	(+24.7)	_____	370 _____	_____	
ΔV TPF	(+31.6)	_____	371 _____	_____	
ΔVX	N81	_____	450 _____	N81* _____	ΔVX _____
ΔVY		_____	451 _____	* _____	
ΔVZ		_____	452 _____	* _____	ΔVZ _____

*CHANGE SIGN
BIAS; ΔVX = -1.0
ΔVZ = +2.0

TPI PAD

+ 0 0 _ _ _ + 0 0 _ _ _	HRS(174) N37
+ 0 0 0 _ _ + 0 0 0 _ _	MIN(29) TPI
+ 0 _ _ . _ _ + 0 _ _ . _ _	SEC(02.88)
R1(+00000),R2(+026.60),R3(+130.00)	N55
_ 0 _ _ . _ _ _ 0 _ _ . _ _	ΔVX(+21.9)N81
_ 0 _ _ . _ _ _ 0 _ _ . _ _	ΔVY(-1.0)LV
_ 0 _ _ . _ _ _ 0 _ _ . _ _	ΔVZ(-11.0)
+ 0 _ _ . _ _ + 0 _ _ . _ _	R(+37.68) N54 TPI
- 0 _ _ . _ _ - 0 _ _ . _ _	Ṙ(-111.7)TIG-5
X X _ _ . _ _ X X _ _ . _ _	BT(00:23)

TIG	N37	_____	373 _____	N37 _____	
θ LOS	N55	_____	303 _____	N55 _____	
HP	N58	_____	402 _____	N58 _____	
ΔV TPI		_____	370 _____	_____	
ΔV TPF		_____	371 _____	_____	
ΔVX	N81	_____	450 _____	N81* _____	ΔVX _____
ΔVY		_____	451 _____	* _____	
ΔVZ		_____	452 _____	* _____	ΔVZ _____

RESIDUALS

PGNS		AGS	
ΔVX	N85	ΔVX	500
ΔVY		ΔVY	501
ΔVZ		ΔVZ	502

PAGE 11

P76/77/P27 PADS

P76/77 PAD

	PURPOSE	
+ 0 0 . . .	HRS	N33
+ 0 0 0 . .	MIN	TIG
+ 0	SEC	
. . . . .	ΔVX	N84/N81
. . . . .	ΔVY	
. . . . .	ΔVZ	
	PURPOSE	
+ 0 0 . . .	HRS	N33
+ 0 0 0 . .	MIN	TIG
+ 0	SEC	
. . . . .	ΔVX	N84/N81
. . . . .	ΔVY	
. . . . .	ΔVZ	
	PURPOSE	
+ 0 0 . . .	HRS	N33
+ 0 0 0 . .	MIN	TIG
+ 0	SEC	
. . . . .	ΔVX	N84/N81
. . . . .	ΔVY	
. . . . .	ΔVZ	
	PURPOSE	
+ 0 0 . . .	HRS	N33
+ 0 0 0 . .	MIN	TIG
+ 0	SEC	
. . . . .	ΔVX	N84/N81
. . . . .	ΔVY	
. . . . .	ΔVZ	

P27 PAD

			PURP	
V : :	V : :	V : :		
INDEX	INDEX	INDEX	01	1173
			02	
			03	
			04	
			05	
			06	
			07	
			10	
			11	
			12	
			13	
			14	
			15	
			16	
			17	
			20	
			21	1213
			22	
			23	
			24	1216

X X X . . .	X X X . . .	HRS
X X X X . .	X X X X . .	MIN
X X	X X	SEC NAV CHECK
. 0	. 0	LAT N43
. . . . .	. . . . .	LONG
+ 0	+ 0	ALT

PAGE 12

DATE 6/10/71

AGS SV/IMPACT PAD

AGS STATE VECTOR PAD	PURP	LOAD
	240	
	241	
	242	
	260	
	261	
	262	
	254	414+2
	244	
	245	
	246	
	264	
	265	
	266	
	272	414+3

AGS STATE VECTOR PAD/LM INSERT	PURP	LOAD
+56613	240	
+00010	241	
+10108	242	
-0941.4	260	
-0000.2	261	
+5455.8	262	
+0104.7	254	414+2
+57305	244	
+00010	245	
+19477	246	
-1721.6	264	
-0000.6	265	
+5064.1	266	
+0104.7	272	414+3

IMPACT CARD	
+00 + 00	HRS (179) N33
+000 + 000	MIN (06) TIG
+0 + 0	SEC (22.70)
	ΔVX (-161.1) N81
	ΔVY (+57.3) LV
	ΔVZ (+94.6)
+ +	H_A (+62.0) N42
	H_P (-52.8)
+ +	ΔVR (+195.4)
XXX XXX	BT (1:22)
XXX XXX	R (037) FDAI
XXX XXX	P (016) INER
+ +	TIG (546.4) 373
	ΔVX (-164.3) N86
	ΔVY (+57.3) AGS
	ΔVZ (+90.0)

DATE ~~6/10/71~~ 7/8/71

P30 PAD

P30		
+ 0 0	+ 0 0	HRS N33
+ 0 0 0	+ 0 0 0	MIN TIG
+ 0	+ 0	SEC
		ΔVX N81
		ΔVY LV
		ΔVZ
+	+	HA N42
		HP
+	+	ΔVR
X X X	X X X	BT
X X X	X X X	R FDAI
X X X	X X X	P INER
+	+	TIG 373
		ΔVX N86
		ΔVY AGS
		ΔVZ
X X X	X X X	BSS
X X	X X	SPA
X X X	X X X	SXP

RESIDUALS			
PGNS		AGS	
ΔVX N85		ΔVX	500
ΔVY		ΔVY	501
ΔVZ		ΔVZ	502

P30		
+ 0 0	+ 0 0 1 7 9	HRS N33
+ 0 0 0	+ 0 0 0 0 6	MIN TIG
+ 0	+ 0 2 2 5 0	SEC
	− 0 1 2 1 9	ΔVX N81
	+ 0 0 5 6 0	ΔVY LV
	+ 0 1 4 8 8	ΔVZ
+	+ 0 0 7 1 1	HA N42
	− 0 0 3 7 1	HP
+	+ 0 2 0 0 3	ΔVR
X X X	X X X 1 2 7	BT
X X X	X X X 0 4 7	R FDAI
X X X	X X X 1 7 4	P INER
+	+ NA	TIG 373
		ΔVX N86
		ΔVY AGS
		ΔVZ
X X X	X X X	BSS
X X	X X	SPA 5444
X X X	X X X	SXP

RESIDUALS			
PGNS		AGS	
ΔVX N85		ΔVX	500
ΔVY		ΔVY	501
ΔVZ		ΔVZ	502

DATE 6/10/71

ASCENT/CSI PADS

LM ASCENT PAD																			
+	0	0				+	0	0				+	0	0				HRS	N33
+	0	0	0			+	0	0	0			+	0	0	0			MIN	TIG
+	0			.		+	0			.		+	0			.		SEC	
+					.	+					.	+					.	V (HOR)	
+					.	+					.	+					.	V (VERT)	N76
	0				.		0				.		0				.	*CROSSRANGE	
												+						047	
												+						053	
												+						224/226	
												+						231	
					.						.	+					.	465	
					.						.	+					.	373	
+	0	0				+	0	0				+	0	0				HRS	N37
+	0	0	0			+	0	0	0			+	0	0	0			MIN	TPI
+	0			.		+	0			.		+	0			.		SEC	
+						+						+						LM WT	

*NOTE: LOAD 8 NM CROSSRANGE IF GREATER THAN 8 NM

CSI PAD													
+	0	0				+	0	0				HRS	N11
+	0	0	0			+	0	0	0			MIN	CSI
+	0			.		+	0			.		SEC	
R_1(+00001), R_2(+026.60), R_3(+130.00)												N55	
+	0	0				+	0	0				HRS	N37
+	0	0	0			+	0	0	0			MIN	TPI
+	0			.		+	0			.		SEC	
	0				.		0				.	ΔVX	N81
	0				.		0				.	ΔVY	LV
410+1, 605+00777, 416+1, 623+0													
+					.	+					.	373	
+					.	+					.	275	
	0				.		0				.	ΔVX	
	0				.		0				.	ΔVY	AGS
	0				.		0				.	ΔVZ	

	DOS O_2 CLOSE BOTH
(1)	IF LEAK STOPS ~~HOSE~~ ~~HOSE~~ VALVE CLOSE
	& URINE QD
(2)	THEN POSSIBLY CYCLE OPEN ON DUMP VALVES

PAGE 17

P76/77/P27 PADS

P76/77 PAD

											PURPOSE	
+	0	0				+	0	0			HRS	N33
+	0	0	0			+	0	0	0		MIN	TIG
+	0			•		+	0			•	SEC	
					•						ΔVX	N84/N81
					•						ΔVY	
					•						ΔVZ	
											PURPOSE	
+	0	0				+	0	0			HRS	N33
+	0	0	0			+	0	0	0		MIN	TIG
+	0			•		+	0			•	SEC	
					•						ΔVX	N84/N81
					•						ΔVY	
					•						ΔVZ	
											PURPOSE	
+	0	0				+	0	0			HRS	N33
+	0	0	0			+	0	0	0		MIN	TIG
+	0			•		+	0			•	SEC	
					•						ΔVX	N84/N81
					•						ΔVY	
					•						ΔVZ	
											PURPOSE	
+	0	0				+	0	0			HRS	N33
+	0	0	0			+	0	0	0		MIN	TIG
+	0			•		+	0			•	SEC	
					•						ΔVX	N84/N81
					•						ΔVY	
					•						ΔVZ	

P27 PAD

V			V			V			PURP	
:	:		:	:		:	:			
INDEX			INDEX			INDEX			01	1173
									02	
									03	
									04	
									05	
									06	
									07	
									10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									20	
									21	1213
									22	
									23	
									24	1216

X	X	X				X	X	X				HRS
X	X	X	X			X	X	X	X			MIN
X	X			•		X	X			•		SEC NAV CHECK
	0			•			0			•		LAT N43
				•						•		LONG
+	0				•	+	0				•	ALT

DATE 6/28/71

PAGE 19

SHADOW DATA

EXTRA P27 PAD

AGS SV/IMPACT P30

COELLIPTIC TPI P76/77/P27

CSI CDH/PLANE CHANGE

ABORT/ASCENT DIRECT TPI

PDI2/PDI2 ABORT LUNAR SURFACE

PD P

ASCENT/CSI NOTES

	CDT	SUN ANGLE	SHADOW LENGTH (METERS)	SHADOW LENGTH (FEET)
July 30	1715	12.0°	28.6	94.0
	1800	12.4°	27.9	91.5
	1900	12.8°	26.8	88.0
	2000	13.3°	25.9	85.0
	2100	13.8°	25.0	82.0
	2200	14.2°	24.4	80.0
	2300	14.7°	23.3	76.5
July 31	0000	15.1°	22.5	74.0
	0100	15.5°	22.1	72.5
	0200	16.0°	21.3	70.0
	0300	16.5°	20.6	67.5
	0400	16.9°	20.1	66.0
	0500	17.4°	19.5	64.0
	0600	17.8°	19.0	62.5
	0700	18.3°	18.4	60.5
	0800	18.7°	18.0	59.0
	0900	19.2°	17.8	58.4
	1000	19.6°	17.1	56.0
	1100	20.0°	16.8	55.0
	1200	20.5°	16.3	53.5
	1300	21.0°	15.8	52.0
	1400	21.4°	15.5	51.0
	1500	21.9°	15.2	50.0
	1600	22.3°	14.9	49.0
	1700	22.8°	14.6	48.0
	1800	23.2°	14.3	47.0
	1900	23.6°	14.0	46.0
	2000	24.1°	13.7	45.0
	2100	24.5°	13.4	44.0
	2200	24.0°	13.1	43.0
	2300	25.4°	12.8	42.0
Aug 1	0000	25.9°	12.5	41.0
	0100	26.3°	12.3	40.5
	0200	26.8°	12.0	39.5
	0300	27.2°	11.9	39.0
	0400	27.6°	11.6	38.0
	0500	28.1°	11.4	37.5
	0600	28.5°	11.3	37.0
	0700	29.0°	11.0	36.0
	0800	29.4°	10.8	35.5
	0900	29.8°	10.7	35.0
	1000	30.3°	10.4	34.0
	1100	30.7°	10.4	34.0
	1200	31.2°	10.1	33.0
	1300	31.6°	9.9	32.5
	1400	32.0°	9.7	32.0
	1500	32.5°	9.6	31.5
	1600	32.9°	9.4	31.0
	1700	33.3°	9.3	30.5
	1800	33.8°	9.1	30.0
	1900	34.2°	9.0	29.5
	2000	34.6°	8.8	29.0
	2100	35.1°	8.7	28.5
	2200	35.5°	8.5	28.0
	2300	35.9°	8.4	27.5
Aug 2	0000	36.3°	8.2	27.0
	0100	36.8°	8.2	27.0
	0200	37.2°	8.1	26.5
	0300	37.6°	7.9	26.0
	0400	38.0°	7.8	25.5
	0500	38.5°	7.6	25.0
	0600	38.9°	7.6	25.0
	0700	39.3°	7.4	24.5
	0800	39.7°	7.3	24.0
	0900	40.1°	7.3	24.0
	1000	40.6°	7.0	23.0
	1100	41.0°	7.0	23.0
	1200	41.4°	7.0	23.0
	1300	41.8°	6.9	22.5

AGS SV/IMPACT P30

COELLIPTIC TPI P76/77/P27

CSI CDH/PLANE CHANGE

ABORT/ASCENT DIRECT TPI

P

ASCENT/CSI NOTES