LAUNCH AND BURN SCHEDULE

TRANSLUNAR INJECTION
MIDCOURSE CORRECTIONS
LUNAR ORBIT INSERTION
DESCENT ORBIT INSERTION
LM DESCENT AND LANDING
LM ASCENT AND RENDEZVOUS
TRANSEARTH INJECTION
MIDCOURSE CORRECTIONS
ENTRY

PRELAUNCH IMU COMPENSATION

CM

POSITION	GYRO DRIFTS			PIPA	
	NBD (meru)	ADIA (meru/g)	ADSRA (meru/g)	BIAS (cm/s^2)	SCALE FACTOR (ppm)
X					
Y					
Z					

LM

POSITION	GYRO DRIFTS			PIPA	
	NBD (meru)	ADIA (meru/g)	ADSRA (meru/g)	BIAS (cm/s^2)	SCALE FACTOR (ppm)
X					
Y					
Z					

IMU COMPENSATION UPDATES

SPACECRAFT (CM or LM)	POSITION	GYRO NBD (meru)	PIPA BIAS (cm/s^2)	TIME OF UPDATE GET		
				h	min	s
	X					
	Y					
	Z					
	X					
	Y					
	Z					
	X					
	Y					
	Z					
	X					
	Y					
	Z					
	X					
	Y					
	Z					

Apollo 16 CM Powered Maneuver Summary

EVENT	TYPICAL G. E. T. (h:min:s)	PROPULSION SYSTEM	BURN DURATION (s)	ULLAGE DURATION (s)	TOTAL ΔV (ft/s)	RESULTANT hp/ha* (nmi)	GUIDANCE MODE	REFSMMAT
Orbit Insertion	00:11:53.4	—	—	—	—	90/90	—	Launch Pad
TLI	2:33:15.1	S-IVB	344.2	—	10,374.3	—	S-IVB/IU	Launch Pad
CSM/LM Ejection	3:58:50	SM-RCS	3	—	1.2	—	EXT ΔV	Launch Pad
S-IVB Evasive Maneuver	4:21:50	S-IVB APS	—	—	9.4	—	S-IVB/IU	Launch Pad
S-IVB LOX Dump	4:43:00	S-IVB LOX	—	—	28	—	S-IVB/IU	Launch Pad
S-IVB Impact Maneuver	5:30:00	S-IVB APS	—	—	30	Lunar Impact	S-IVB/IU	Launch Pad
MCC_1	11:38:50.0	SPS/RCS	Nom Zero	0	Nom Zero	—	Ext ΔV	PTC
MCC_2	30:38:50.0	SPS/RCS	Nom Zero	0	Nom Zero	—	Ext ΔV	PTC
MCC_3	52:28:38.6	SPS/RCS	Nom Zero	0	Nom Zero	—	Ext ΔV	PTC
MCC_4	69:28:38.6	SPS/RCS	Nom Zero	0	Nom Zero	—	Ext ΔV	PTC
LOI	74:28:38.6	SPS	375.0	0	2,807.0	58.5/170.6	Ext ΔV	Preferred
S-IVB Lunar Impact	74:30:08	—	—	—	—	2.3° S/31.7° W	—	—
DOI	78:35:30.3	SPS	24.1	15	206.0	10.9/58.6	Ext ΔV	Landing Site
CSM/LM Undocking and Sep.	96:13:30.8	SM-RCS	3.5	0	1.0	8.8/59.8	Ext ΔV	Landing Site
CSM Circularization	97:41:44.5	SPS	5.9	16	99.6	51.8/68.2	Ext ΔV	Landing Site
CSM Plane Change 1	152:28:48.1	SPS	9.1	16	158.7	57.3/62.0	Ext ΔV	Preferred
LM Jettison	177:31:15.0	—	—	—	—	—	—	—
CSM/LM Separation	177:36:15.0	SM-RCS	13.2	0	2	59.5/61.7	Ext ΔV	Liftoff
CSM Plane Change 2	193:13:46.2	SPS	15.8	16	282.5	57.9/62.9	Ext ΔV	Preferred
Shaping Burn	216:49:11.7	SPS	2.2	17	38.0	55.0/85.0	Ext ΔV	Liftoff
TEI	222:20:32.8	SPS	150.5	17	3,212.2	—	Ext ΔV	Preferred
MCC_5	239:23:03.3	SPS/RCS	Nom Zero	0	Nom Zero	—	Ext ΔV	PTC
MCC_6	268:22:45.4	SPS/RCS	Nom Zero	0	Nom Zero	—	Ext ΔV	PTC
MCC_7	287:22:45.4	SPS/RCS	Nom Zero	0	Nom Zero	—	Ext ΔV	Entry
Entry	290:22:45.4	—	—	—	Nom Zero	—	Ext ΔV	Entry

*Above Lunar Landing Site (Lunar Orbit)

LB-4

Apollo 16 LM Powered Maneuver Summary

EVENT	TYPICAL G. E. T. (h:min:s)	PROPULSION SYSTEM	BURN DURATION (s)	ULLAGE DURATION (s)	TOTAL ΔV (ft/s)	RESULTANT hp/ha* (nmi)	GUIDANCE MODE	REFSMMAT
PDI	98:34:40.9	DPS	721.5	7.5	6,696.3	—	PGNS	Landing Site
Touchdown	98:46:42.4							
Ascent	171:45:08.6	APS	434.3	0	6,047.9	9.0/45.4	PGNS	Liftoff
Insertion	171:52:22.9							
Tweak	171:55:22.9	RCS	Nom Zero	0	Nom Zero	—	PGNS	Liftoff
TPI (Ullage On)	172:39:12.9	APS	12.5	10.5	72.1	44.0/61.9	Lambert	Liftoff
MCC_1	172:54:25.4	RCS	Nom Zero	0	Nom Zero	—	Lambert	Liftoff
MCC_2	173:09:25.4	RCS	Nom Zero	0	Nom Zero	—	Lambert	Liftoff
1st Braking Maneuver	173:20:16.4	RCS	12.9	0	14.2	52.5/61.4	Manual	Liftoff
2nd Braking Maneuver	173:21:29.3	RCS	8.8	0	9.7	55.7/60.5	Manual	Liftoff
3rd Braking Maneuver	173:23:07.6	RCS	4.3	0	4.8	57.4/60.1	Manual	Liftoff
4th Braking Maneuver	173:24:27.2	RCS	4.2	0	4.7	59.3/59.8	Manual	Liftoff
LM Deorbit	179:16:29.2	RCS	95.5	95.5	229.6		PGNS	Liftoff
LM Impact	179:39:28.6	—	—	—	—	—	—	—

*Above Lunar Landing Site

LB-5

APOLLO 16

EVENT	DATE	TIME (H:M:S) C.S.T.	TIME (H:M:S) G.E.T.
DAY 1 ACTIVITIES			
LIFTOFF - P02 TO P11	APRIL 16, 1972	11:54: 0.	0: 0: 0.
ENABLE TOWER CLEARANCE YAW MANEUVER	APRIL 16, 1972	11:54: 1.	0: 0: 1.
TERMINATE YAW MANEUVER	APRIL 16, 1972	11:54: 9.	0: 0: 9.
PITCH AND ROLL INITIATION	APRIL 16, 1972	11:54:12.	0: 0:12.
S-IC CENTER-ENGINE CUTOFF	APRIL 16, 1972	11:56:18.	0: 2:18.
S-IC OUTBOARD-ENGINE CUTOFF	APRIL 16, 1972	11:56:40.	0: 2:40.
S-IC/S-II SEPARATION	APRIL 16, 1972	11:56:42.	0: 2:42.
S-II IGNITION	APRIL 16, 1972	11:56:44.	0: 2:44.
LET JETTISON	APRIL 16, 1972	11:57:18.	0: 3:18.
S-II CENTER-ENGINE CUTOFF	APRIL 16, 1972	12: 1:40.	0: 7:40.
S-II OUTBOARD-ENGINE CUTOFF	APRIL 16, 1972	12: 9:17.	0: 9:17.
S-II/S-IVB SEPARATION	APRIL 16, 1972	12: 9:18.	0: 9:18.
S-IVB IGNITION	APRIL 16, 1972	12: 9:21.	0: 9:21.
S-IVB FIRST GUIDANCE CUTOFF	APRIL 16, 1972	12: 5:44.	0:11:44.
PARKING ORBIT INSERTION	APRIL 16, 1972	12: 5:54.	0:11:54.
P52 IMU REALIGN (OPT 3 : LAUNCH)	APRIL 16, 1972	12:31: 0.	0:37: 0.
TLI PAD (LB-14), TLI+90 MIN ABORT PAD (LB-15),P37 L/D+8 PAD (LB-17)	APRIL 16, 1972	13:24: 0.	1:30: 0.
TB6	APRIL 16, 1972	14:17:57.	2:23:57.
S-IVB REIGNITION	APRIL 16, 1972	14:27:35.	2:33:35.
S-IVB SECOND GUIDANCE CUTOFF	APRIL 16, 1972	14:33:19.	2:39:19.
TLI	APRIL 16, 1972	14:33:29.	2:39:29.
S-IVB MANEUVER TO SEPARATION ATTITUDE	APRIL 16, 1972	14:48:20.	2:54:20.
CSM/S-IVB SEPARATION	APRIL 16, 1972	14:58:20.	3: 4:20.
CSM-LM DOCKING	APRIL 16, 1972	15: 8:20.	3:14:20.
CSM/LM EJECTION	APRIL 16, 1972	15:53:20.	3:59:20.
S-IVB YAW MANEUVER	APRIL 16, 1972	16: 6:20.	4:12:20.
S-IVB APS EVASIVE BURN	APRIL 16, 1972	16:16:20.	4:22:20.
S-IVB LOX DUMP	APRIL 16, 1972	16:37: 0.	4:43: 0.
P52 IMU REALIGN (OPT 3 : LAUNCH)	APRIL 16, 1972	17:21: 0.	5:27: 0.
P52 IMU REALIGN (OPT 1 : PTC)	APRIL 16, 1972	17:32: 0.	5:38: 0.
P37 L/D+15 PAD (LB-20)	APRIL 16, 1972	17:49: 0.	5:55: 0.
EARTH DISTANCE APPROX. 33,300 NM	APRIL 16, 1972	18:54: 0.	7: 0: 0.
EARTH DISTANCE APPROX. 38,900 NM	APRIL 16, 1972	19:54: 0.	8: 0: 0.
P23 CISLUNAR NAVIGATION (LB-21)	APRIL 16, 1972	20: 0: 0.	8: 6: 0.
MCC-1 P30 MNVR PAD (LB-24)	APRIL 16, 1972	22:21: 0.	10:27: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 16, 1972	22:34: 0.	10:40: 0.
P30 EXTERNAL DELTA-V (IF MCC-1 REQ'D)	APRIL 16, 1972	22:57: 0.	11: 3: 0.
P40/P41 SPS/RCS THRUSTING (IF MCC-1 REQ'D) (LB-25)	APRIL 16, 1972	23: 8: 0.	11:14: 0.

APOLLO 16

EVENT	DATE	TIME (H:M:S) C.S.T.	TIME (H:M:S) G.E.T.
DAY 1 ACTIVITIES CONTD			
MCC-1 (IF REQ'D)	APRIL 16, 1972	23:33: 0.	11:39: 0.
EARTH DISTANCE APPROX. 58,100 NM	APRIL 16, 1972	23:54: 0.	12: 0: 0.
P37 L/D+25,35,45,55 PADS (LB-26)	APRIL 17, 1972	1:24: 0.	13:30: 0.
EARTH DISTANCE APPROX. 68,400 NM	APRIL 17, 1972	2:24: 0.	14:30: 0.
EARTH DISTANCE APPROX. 97,700 NM	APRIL 17, 1972	10:54: 0.	23: 0: 0.
DAY 2 ACTIVITIES			
MCC-2 P30 MNVR PAD (LB-27)	APRIL 17, 1972	17:30: 0.	29:36: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 17, 1972	17:39: 0.	29:45: 0.
EARTH DISTANCE APPROX. 117,600 NM	APRIL 17, 1972	17:54: 0.	30: 0: 0.
P30 EXTERNAL DELTA-V (IF MCC-2 REQ'D)	APRIL 17, 1972	17:58: 0.	30: 4: 0.
P40/P41 SPS/RCS THRUSTING (IF MCC-2 REQUIRED) (LB-28)	APRIL 17, 1972	18:11: 0.	30:17: 0.
MCC-2 (IF REQUIRED)	APRIL 17, 1972	18:33: 0.	30:39: 0.
EARTH DISTANCE APPROX. 122,800 NM	APRIL 17, 1972	19:54: 0.	32: 0: 0.
LM INGRESS	APRIL 17, 1972	20:59: 0.	33: 5: 0.
LM EGRESS	APRIL 17, 1972	22:54: 0.	35: 0: 0.
EARTH DISTANCE APPROX. 132,500 NM	APRIL 17, 1972	23:54: 0.	36: 0: 0.
EARTH DISTANCE APPROX. 154,300 NM	APRIL 18, 1972	9:54: 0.	46: 0: 0.
DAY 3 ACTIVITIES			
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 18, 1972	13: 9: 0.	49:15: 0.
MCC-3 P30 MNVR PAD (LB-29)	APRIL 18, 1972	15:24: 0.	51:30: 0.
P30 EXTERNAL DELTA-V (IF MCC-3 REQ'D)	APRIL 18, 1972	15:48: 0.	51:54: 0.
P40/P41 SPS/RCS THRUSTING (IF MCC-3 REQUIRED) (LB-30)	APRIL 18, 1972	16: 1: 0.	52: 7: 0.
MCC-3 (IF REQUIRED)	APRIL 18, 1972	16:23: 0.	52:29: 0.
LM INGRESS	APRIL 18, 1972	17:44: 0.	53:50: 0.
LM EGRESS	APRIL 18, 1972	18:39: 0.	54:45: 0.
EARTH DISTANCE APPROX. 176,400 NM	APRIL 18, 1972	21:54: 0.	58: 0: 0.
EARTH DISTANCE APPROX. 189,400 NM	APRIL 19, 1972	5:54: 0.	66: 0: 0.
MCC-4 P30 MNVR PAD AND PERICYNTHION+2HR ABORT PAD (LB-31)	APRIL 19, 1972	7:54: 0.	68: 0: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 19, 1972	8:18: 0.	68:24: 0.
P30 EXTERNAL DELTA-V (IF MCC-4 REQ'D)	APRIL 19, 1972	8:48: 0.	68:54: 0.
EARTH DISTANCE APPROX. 194,100 NM	APRIL 19, 1972	8:54: 0.	69: 0: 0.
P40/P41 SPS/RCS THRUSTING (IF MCC-4 REQUIRED) (LB-32)	APRIL 19, 1972	9: 8: 0.	69:14: 0.
MCC-4 (IF REQUIRED)	APRIL 19, 1972	9:23: 0.	69:29: 0.

APOLLO 16

EVENT	DATE	TIME (H:M:N:S) C.S.T.	TIME (H:M:N:S) G.E.T.
DAY 3 ACTIVITIES CONTD			
SIM DOOR JETTISON (LB-33)	APRIL 19, 1972	9:53: 0.	69:59: 0.
LOI MNVR PAD : PRELIMINARY (LB-35)	APRIL 19, 1972	10:14: 0.	70:20: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 19, 1972	11:27: 0.	71:33: 0.
P52 IMU REALIGN (OPT 1 : LOI)	APRIL 19, 1972	11:36: 0.	71:42: 0.
DAY 4 ACTIVITIES			
TEI 4 PAD (LB-35)	APRIL 19, 1972	12:16: 0.	72:22: 0.
LOI MNVR PAD (LB-36)	APRIL 19, 1972	13:15: 0.	73:21: 0.
P30 EXTERNAL DELTA-V	APRIL 19, 1972	13:30: 0.	73:36: 0.
P40 SPS THRUSTING	APRIL 19, 1972	13:54: 0.	74: 0: 0.
LOI	APRIL 19, 1972	14:22:38.	74:28:39.
S-IVB LUNAR IMPACT (2.28 S, 31.79 W)	APRIL 19, 1972	14:24: 8.	74:30: 8.
P52 IMU REALIGN (OPT 3 : LOI)	APRIL 19, 1972	15:39: 0.	75:45: 0.
P52 IMU REALIGN (OPT 1 : LDG SITE)	APRIL 19, 1972	15:44: 0.	75:50: 0.
DOI MNVR PAD AND TEI 5 PAD (LB-38), P24 PAD (LB-40)	APRIL 19, 1972	17:30: 0.	77:36: 0.
P52 IMU REALIGN (OPT 3 : LDG SITE)	APRIL 19, 1972	17:47: 0.	77:53: 0.
P30 EXTERNAL DELTA-V	APRIL 19, 1972	17:57: 0.	78: 3: 0.
P40 SPS THRUSTING	APRIL 19, 1972	17:58: 0.	78: 4: 0.
DOI	APRIL 19, 1972	18:29:30.	78:35:30.
P47 BAILOUT BURN (IF REQUIRED)	APRIL 19, 1972	19:16: 8.	79:22: 8.
P24 LANDMARK TRACKING	APRIL 19, 1972	19:24: 0.	79:30: 0.
TEI 12 AND TEI 19 P30 MNVR PADS (LB-42)	APRIL 19, 1972	21:24: 0.	81:30: 0.
P52 IMU REALIGN (OPT 3 : LDG SITE)	APRIL 19, 1972	21:34: 0.	81:40: 0.
P52 IMU REALIGN (OPT 3 : LDG SITE)	APRIL 20, 1972	8:57: 0.	93: 3: 0.
LM INGRESS	APRIL 20, 1972	9:39: 0.	93:45: 0.
LM PGNS TURN-ON	APRIL 20, 1972	10:11: 0.	94:17: 0.
UNDOCK/SEPARATION PAD (LB-43), P24 PAD (LB-44)	APRIL 20, 1972	10:33: 0.	94:39: 0.
DOCKED IMU COARSE ALIGN	APRIL 20, 1972	10:41: 0.	94:47: 0.
P52 (LM) IMU REALIGN (OPT 3 : LDG SITE) (CURSOR/SPIRAL TECHNIQUE)	APRIL 20, 1972	10:54: 0.	95: 0: 0.
P30 EXTERNAL DELTA-V (CSM)	APRIL 20, 1972	11:50: 0.	95:56: 0.
DAY 5 ACTIVITIES			
P41 RCS THRUSTING (CSM) (LB-48)	APRIL 20, 1972	12: 1: 0.	96: 7: 0.
P47 THRUST MONITOR (LM) (LB-49)	APRIL 20, 1972	12: 7: 0.	96:13: 0.
CSM/LM UNDOCKING AND SEPARATION	APRIL 20, 1972	12: 7:31.	96:13:31.
P24 LANDMARK TRACKING	APRIL 20, 1972	12:35: 0.	96:41: 0.
CSM CIRC PAD (LB-50), NO PDI+12 ABORT PAD (LB-52), PDI PAD (LB-53), PDI ABORT PADS (LB-54,55)	APRIL 20, 1972	12:42: 0.	96:48: 0.

APOLLO 16

EVENT	DATE	TIME (H:M:N:S) C.S.T.	TIME (H:M:N:S) G.E.T.
DAY 5 ACTIVITIES CONTD			
P52 (CM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 20, 1972	12:45: 0.	96:51: 0.
P52 (LM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 20, 1972	12:48: 0.	96:54: 0.
P52 COAS CALIBRATION (CM)	APRIL 20, 1972	12:54: 0.	97: 0: 0.
P30 EXTERNAL DELTA-V (CM)	APRIL 20, 1972	13: 0: 0.	97: 6: 0.
LPD CALIBRATION	APRIL 20, 1972	13: 4: 0.	97:10: 0.
P40 SPS THRUSTING (CM)	APRIL 20, 1972	13:11: 0.	97:17: 0.
CSM CIRCULARIZATION	APRIL 20, 1972	13:35:45.	97:41:45.
P76 UPDATE CSM STATE VECTOR (LM) (LB-56)	APRIL 20, 1972	13:36: 0.	97:42: 0.
P63 IGNITION ALGORITHM TEST	APRIL 20, 1972	13:41: 0.	97:47: 0.
P24 LANDMARK TRACKING (LB-57)	APRIL 20, 1972	14: 9: 0.	98:15: 0.
PDI	APRIL 20, 1972	14:28:41.	98:34:41.
LM LUNAR TOUCHDOWN	APRIL 20, 1972	14:40:42.	98:46:42.
P52 (CM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 20, 1972	14:52: 0.	98:58: 0.
P57 LUNAR SURFACE ALIGN (OPT 3 : LDG SITE, TECH 3 : G & ONE STAR)	APRIL 20, 1972	14:59: 0.	99: 5: 0.
LM PGNS POWER DOWN	APRIL 20, 1972	15:11: 0.	99:17: 0.
P24 LANDMARK TRACKING (LB-115)	APRIL 20, 1972	16: 4: 0.	100:10: 0.
START EVA-1	APRIL 20, 1972	16:19: 0.	100:25: 0.
P52 (CM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 20, 1972	22:48: 0.	106:54: 0.
TEI 26 PAD (LB-117)	APRIL 21, 1972	0:52: 0.	108:58: 0.
END EVA-1	APRIL 21, 1972	1:19: 0.	109:25: 0.
P52 (CM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 21, 1972	10:35: 0.	118:41: 0.
DAY 6 ACTIVITIES			
TEI 32 PAD (LB-117)	APRIL 21, 1972	14: 5: 0.	122:11: 0.
START EVA-2	APRIL 21, 1972	16:44: 0.	124:50: 0.
P52 (CM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 21, 1972	17: 0: 0.	125: 6: 0.
P52 (CM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 21, 1972	22:35: 0.	130:41: 0.
END EVA-2	APRIL 21, 1972	23:44: 0.	131:50: 0.
TEI 42 PAD (LB-118)	APRIL 22, 1972	0:26: 0.	132:32: 0.
DAY 7 ACTIVITIES			
P52 (CM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 22, 1972	12:24: 0.	144:30: 0.
START EVA-3	APRIL 22, 1972	16:19: 0.	148:25: 0.
LOPC-1 MNVR PAD AND TEI 53 PAD (LB-119)	APRIL 22, 1972	17:34: 0.	149:40: 0.
P52 (CM) IMU REALIGN (OPT 3 : LDG SITE)	APRIL 22, 1972	18:26: 0.	150:32: 0.
P52 (CM) IMU REALIGN (OPT 1 : LOPC-1)	APRIL 22, 1972	18:30: 0.	150:36: 0.

APOLLO 16

EVENT	DATE	TIME (HIMIN:S) G.E.T.	TIME (HIMIN:S) G.E.T.
DAY 7 ACTIVITIES CONTD			
P30 EXTERNAL DELTA-V	APRIL 22, 1972	19:39: 0.	151:39: 0.
P40 SPS THRUSTING	APRIL 22, 1972	20: 9: 0.	152:14: 0.
LOPC-1	APRIL 22, 1972	20:22:48.	152:28:48.
P52 (CM) IMU REALIGN (OPT 1 : LIFT OFF)	APRIL 22, 1972	20:42: 0.	152:48: 0.
END EVA-3	APRIL 22, 1972	23:19: 0.	155:25: 0.
P52 (CM) IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 23, 1972	8:10: 0.	164:16: 0.
P24 PAD (LB-122)	APRIL 23, 1972	11:24: 0.	167:30: 0.
LM PGNS TURN-ON	APRIL 23, 1972	11:34: 0.	167:40: 0.
P57 LUNAR SURFACE ALIGN (OPT 4 : LIFT OFF, TECH 3 : G & ONE STAR)	APRIL 23, 1972	11:39: 0.	167:45: 0.
ASCENT PAD (LB-125), CSI PAD (LB-126)	APRIL 23, 1972	11:44: 0.	167:50: 0.
DAY 8 ACTIVITIES			
P22 LUNAR SURFACE NAVIGATION	APRIL 23, 1972	13:31: 0.	169:37: 0.
P52 (CM) IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 23, 1972	14: 5: 0.	170:11: 0.
P52 (CM) COAS CALIBRATION	APRIL 23, 1972	14:10: 0.	170:16: 0.
P57 LUNAR SURFACE ALIGN (OPT 4 : LIFT OFF, TECH 3 : G & ONE STAR)	APRIL 23, 1972	14:56: 0.	171: 2: 0.
P12 POWERED ASCENT	APRIL 23, 1972	15: 7: 0.	171:13: 0.
LM LUNAR LIFT OFF	APRIL 23, 1972	15:39: 9.	171:45: 9.
LUNAR ORBIT INSERTION	APRIL 23, 1972	15:46:23.	171:52:23.
P20 RENDEZVOUS NAVIGATION (LM)	APRIL 23, 1972	15:49: 0.	171:55: 0.
P34 TPI TARGETING (CM)	APRIL 23, 1972	15:50: 0.	171:56: 0.
P34 TPI TARGETING (LM)	APRIL 23, 1972	15:52: 0.	171:58: 0.
P42 APS THRUSTING	APRIL 23, 1972	16:27: 0.	172:33: 0.
TPI	APRIL 23, 1972	16:33:13.	172:39:13.
P35 TPM TARGETING (LM)	APRIL 23, 1972	16:33:50.	172:39:50.
P76 TARGET DELTA-V (CM)	APRIL 23, 1972	16:34: 0.	172:40: 0.
P35 TPM TARGETING (CM)	APRIL 23, 1972	16:36: 0.	172:42: 0.
P41 RCS THRUSTING (LM)	APRIL 23, 1972	16:46: 0.	172:52: 0.
MCC-1 (LM : IF REQ'D)	APRIL 23, 1972	16:48:23.	172:54:23.
P35 TPM TARGETING (LM)	APRIL 23, 1972	16:48:50.	172:54:50.
P76 TARGET DELTA-V (CM : IF MCC-1 PERFORMED)	APRIL 23, 1972	16:49: 0.	172:55: 0.
P35 TPM TARGETING (CM)	APRIL 23, 1972	16:51: 0.	172:57: 0.
P41 RCS THRUSTING	APRIL 23, 1972	17: 1: 0.	173: 7: 0.
MCC-2 (IF REQ'D)	APRIL 23, 1972	17: 3:23.	173: 9:23.
P76 TARGET DELTA-V (CM : IF MCC-2 PERFORMED)	APRIL 23, 1972	17: 3:50.	173: 9:50.

APOLLO 16

EVENT	DATE	TIME (HIMIN:S) G.E.T.	TIME (HIMIN:S) G.E.T.
DAY 8 ACTIVITIES CONTD			
P79 RENDEZVOUS FINAL PROGRAM (CM)	APRIL 23, 1972	17: 5: 0.	173:11: 0.
P47 THRUST MONITOR (LM)	APRIL 23, 1972	17:12: 0.	173:18: 0.
FIRST LM BRAKING MANEUVER	APRIL 23, 1972	17:14:16.	173:20:16.
SECOND LM BRAKING MANEUVER	APRIL 23, 1972	17:15:29.	173:21:29.
THIRD LM BRAKING MANEUVER	APRIL 23, 1972	17:17: 8.	173:23: 8.
FOURTH LM BRAKING MANEUVER	APRIL 23, 1972	17:18:27.	173:24:27.
P47 THRUST MONITOR (CM)	APRIL 23, 1972	17:39: 0.	173:45: 0.
DOCKING	APRIL 23, 1972	17:44: 0.	173:50: 0.
LM JETTISON PAD (LB-140) CSM-SEP PAD (LB-141)	APRIL 23, 1972	19:49: 0.	175:55: 0.
LM DEORBIT BURN PAD (LB-140)	APRIL 23, 1972	19:50: 0.	175:56: 0.
LM JETTISON	APRIL 23, 1972	21:25:15.	177:31:15.
CSM SEPARATION BURN	APRIL 23, 1972	21:30:15.	177:36:15.
TEI 62 PAD (LB-141)	APRIL 23, 1972	21:35: 0.	177:41: 0.
LM DEORBIT BURN	APRIL 23, 1972	23:10:29.	179:16:29.
LM IMPACT (14.98E, 9.50S)	APRIL 23, 1972	23:33:29.	179:39:29.
P52 IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 24, 1972	0: 4: 0.	180:10: 0.
LOPC-2 AND TEI 65 PADS (LB-144)	APRIL 24, 1972	11:11: 0.	191:17: 0.
DAY 9 ACTIVITIES			
P52 IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 24, 1972	11:57: 0.	192: 3: 0.
P52 IMU REALIGN (OPT 1 : LOPC-2)	APRIL 24, 1972	12: 2: 0.	192: 8: 0.
P30 EXTERNAL DELTA-V	APRIL 24, 1972	12: 7: 0.	192:13: 0.
P40 SPS THRUSTING	APRIL 24, 1972	12:56: 0.	193: 2: 0.
LOPC-2	APRIL 24, 1972	13: 7:46.	193:13:46.
P52 IMU REALIGN (OPT 1 : LIFT OFF)	APRIL 24, 1972	13:21: 0.	193:27: 0.
P52 IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 24, 1972	13:55: 0.	194: 1: 0.
P52 IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 24, 1972	18:27: 0.	198:33: 0.
TEI 72 PAD (LB-147)	APRIL 24, 1972	21:19: 0.	201:25: 0.
P52 IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 25, 1972	8: 5: 0.	212:11: 0.
TEI 74 PAD (LB-147)	APRIL 25, 1972	8:53: 0.	212:59: 0.
SHAPE MANEUVER PAD (LB-148)	APRIL 25, 1972	10:48: 0.	214:54: 0.
DAY 10 ACTIVITIES			
P52 IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 25, 1972	11:54: 0.	216: 0: 0.
P30 EXTERNAL DELTA-V	APRIL 25, 1972	12: 4: 0.	216:10: 0.
P40 SPS THRUSTING	APRIL 25, 1972	12:31: 0.	216:37: 0.
SHAPE BURN	APRIL 25, 1972	12:49:12.	216:49:12.
SUBSATELLITE LAUNCH	APRIL 25, 1972	13:56: 8.	218: 2: 8.

APOLLO 16

EVENT	DATE	TIME (HIMIN:S) C.S.T.	TIME (HIMIN:S) G.E.T.
DAY 10 ACTIVITIES CONTD			
TEI 75 PRELIMIARY PAD (LB-151)	APRIL 25, 1972	15:14: 0.	219:20: 0.
P52 IMU REALIGN (OPT 3 : LIFT OFF)	APRIL 25, 1972	16:14: 0.	220:20: 0.
P52 IMU REALIGN (OPT 1 : TEI)	APRIL 25, 1972	16:19: 0.	220:25: 0.
TEI 75 PAD (LB-151) AND TEI 76 PAD (LB-152)	APRIL 25, 1972	16:59: 0.	220:58: 0.
P30 EXTERNAL DELTA-V	APRIL 25, 1972	17:24: 0.	221:30: 0.
P40 SPS THRUSTING	APRIL 25, 1972	17:47: 0.	221:53: 0.
TEI	APRIL 25, 1972	18:14:33.	222:20:33.
P52 IMU REALIGN (OPT 3 : TEI)	APRIL 25, 1972	19:26: 0.	223:32: 0.
P52 IMU REALIGN (OPT 1 : PTC)	APRIL 25, 1972	19:36: 0.	223:42: 0.
EARTH DISTANCE APPROX. 210,100 NM	APRIL 25, 1972	20:54: 0.	225: 0: 0.
EARTH DISTANCE APPROX. 187,800 NM	APRIL 26, 1972	7:54: 0.	236: 0: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 26, 1972	9:24: 0.	237:30: 0.
MCC-5 PAD (LB-154)	APRIL 26, 1972	9:54: 0.	238: 0: 0.
P30 EXTERNAL DELTA-V (IF MCC-5 REQ'D)	APRIL 26, 1972	10:34: 0.	238:40: 0.
P40/P41 SPS/RCS THRUSTING (IF MCC-5 REQUIRED)	APRIL 26, 1972	11: 4: 0.	239:10: 0.
MCC-5 (IF REQUIRED)	APRIL 26, 1972	11:15: 0.	239:21: 0.
DAY 11 ACTIVITIES			
EARTH DISTANCE APPROX. 181,400 NM	APRIL 26, 1972	11:54: 0.	240: 0: 0.
START CSM EVA	APRIL 26, 1972	13:54: 0.	242: 0: 0.
END CSM EVA	APRIL 26, 1972	14:59: 0.	243: 5: 0.
EARTH DISTANCE APPROX. 168,274 NM	APRIL 26, 1972	16:54: 0.	245: 0: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 26, 1972	21:54: 0.	250: 0: 0.
EARTH DISTANCE APPROX. 151,800 NM	APRIL 26, 1972	23:54: 0.	252: 0: 0.
EARTH DISTANCE APPROX. 128,254 NM	APRIL 27, 1972	8:54: 0.	261: 0: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 27, 1972	10:29: 0.	262:35: 0.
DAY 12 ACTIVITIES			
EARTH DISTANCE APPROX. 119,681 NM	APRIL 27, 1972	11:54: 0.	264: 0: 0.
MCC-6 PAD (LB-156)	APRIL 27, 1972	15:14: 0.	267:20: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 27, 1972	15:54: 0.	268: 0: 0.
ENTRY PAD (LB-158)	APRIL 27, 1972	16: 1: 0.	268: 7: 0.
MCC-6 (IF REQUIRED)	APRIL 27, 1972	16:17: 0.	268:23: 0.
P47 THRUST MONITOR (LB-159)	APRIL 27, 1972	17:57: 0.	270: 3: 0.
EARTH DISTANCE APPROX. 87,373 NM	APRIL 27, 1972	21:54: 0.	274: 0: 0.
MCC-7 PAD (LB-160), ENTRY PAD (LB-173)	APRIL 28, 1972	9:42: 0.	285:48: 0.
P52 IMU REALIGN (OPT 3 : PTC)	APRIL 28, 1972	10: 4: 0.	286:10: 0.
P52 IMU REALIGN (OPT 1 : ENTRY)	APRIL 28, 1972	10: 9: 0.	286:15: 0.

APOLLO 16

EVENT	DATE	TIME (HIMIN:S) C.S.T.	TIME (HIMIN:S) G.E.T.
DAY 12 ACTIVITIES CONTD			
P30 EXTERNAL DELTA-V (IF MCC-7 REQ'D)	APRIL 28, 1972	10:34: 0.	286:40: 0.
P40/P41 SPS/RCS THRUSTING (IF MCC-7 REQUIRED)	APRIL 28, 1972	10:59: 0.	287: 5: 0.
MCC-7 (IF REQUIRED)	APRIL 28, 1972	11:17: 0.	287:23: 0.
DAY 13 ACTIVITIES			
EARTH DISTANCE APPROX. 20,900 NM	APRIL 28, 1972	11:54: 0.	288: 0: 0.
P52 IMU REALIGN (OPT 3 : ENTRY)	APRIL 28, 1972	12:37: 0.	288:43: 0.
ENTRY PAD (LB-173)	APRIL 28, 1972	13:29: 0.	289:35: 0.
P61 ENTRY-PREPARATION	APRIL 28, 1972	13:54: 0.	290: 0: 0.
P62 ENTRY - CM/SM SEPARATION AND PREENTRY MANEUVER	APRIL 28, 1972	13:56: 0.	290: 2: 0.
CM/SM SEPARATION	APRIL 28, 1972	14: 1: 0.	290: 7: 0.
ENTRY INTERFACE	APRIL 28, 1972	14:16:45.	290:22:45.
SPLASHDOWN	APRIL 28, 1972	14:30: 3.	290:36: 3.

TLI

X						TB 6p* (h:min:s)	X					
X	X	X				R	X	X	X			
X	X	X				P Predicted Spacecraft IMU Gimbal Angles at TLI Ignition (degrees)	X	X	X			
X	X	X				Y	X	X	X			
X	X	X				BT Duration of TLI (min:s)	X	X	X			
						ΔVC** (ft/s)						
+						VI† (ft/s)	+					
X	X	X				R SEP	X	X	X			
X	X	X				P SEP Predicted S/C IMU Gimbal Angles at Completion of S-IVB Maneuver to CSM/SIV-B Separation Attitude (degrees)	X	X	X			
X	X	X				Y SEP	X	X	X			
X	X	X				R	X	X	X			
X	X	X				P Predicted S/C IMU Gimbal Angles at Extraction	X	X	X			
X	X	X				Y	X	X	X			

*Predicted Time of Beginning of S-IVB Restart Preparation for TLI (TB6 = TLI Ignition - 9 minutes)

**Nominal TLI ΔV Set into EMS ΔV Control

†Nominal Inertial Velocity Displayed on DSKY at TLI Cutoff

P30–EXTERNAL ΔV

TLI + 90

V37 Enter, 30 Enter

V06 N33 Flashing, Load Desired GETI

V06 N81 Flashing, Load Desired ΔV

						Purpose							
			/			Prop/Guidance				/			
+						Weight (lb) N47	+						
	0	0				P_{Trim} N48		0	0				
	0	0				Y_{Trim} (degrees)		0	0				
+	0	0				Hours N33	+	0	0				
+	0	0	0			Minutes GETI	+	0	0	0			
+	0					Seconds	+	0					
						ΔV_X N81							
						ΔV_Y LV							
						ΔV_Z (ft/s)							
X	X	X				R	X	X	X				
X	X	X				P IMU Gimbal Angles (deg)	X	X	X				
X	X	X				Y	X	X	X				
+						H_{Apogee} N44	+						
						$H_{Perigee}$ nmi							
+						ΔVT (ft/s)	+						
X	X	X				BT (min:s)	X	X	X				
X						ΔVC (ft/s)	X						
X	X	X	X			SXT Star	X	X	X	X			
+					0	SFT (degrees)	+					0	
+				0	0	TRN (degrees)	+				0	0	
X	X	X				BSS (Coas Star)	X	X	X				
X	X					SPA (Coas Pitch, deg)	X	X					
X	X	X				SXP (Coas X Pos, deg)	X	X	X				
	0					LAT N61		0					
						LONG (degrees)							
+						RTGO (nmi) EMS	+						
+						VIO (ft/s)	+						
						GET 0.05 g Hr:min:s							
						SET STARS							
X	X	X				R_{Align}	X	X	X				
X	X	X				P_{Align}	X	X	X				
X	X	X				Y_{Align}	X	X	X				
						ULLAGE							

NOTES:

PRO/GUID		PROPULSION SYSTEM (SPS/RCS)/ GUIDANCE (SCS/G&N)
WT	XXXXX (lbs)	PREMANEUVER VEHICLE WEIGHT
P TRIM	X.XX (DEG)	SPS PITCH GIMBAL OFFSET TO PLACE THRUST
Y TRIM	X.XX (DEG)	SPS YAW GIMBAL OFFSET TO PLACE THRUST
GETI	XX:XX:XX (HRS:MIN:SEC)	TIME OF MNVR IGNITION
ΔVX ΔVY ΔVZ	XXXX.X (fps) XXXX.X (fps) XXXX.X (fps)	P30 VELOCITY TO BE GAINED COMPONENTS IN LOCAL VERTICAL COORDINATES
R P Y	XXX (DEG) XXX (DEG) XXX (DEG)	IMU GIMBAL ANGLES OF MANEUVER ATTITUDE
H_A	XXXX.X (nm)	PREDICTED APOGEE ALTITUDE AFTER MANEUVER
H_P	XXXX.X (nm)	PREDICTED PERIGEE ALTITUDE AFTER MANEUVER
ΔVT	XXXX.X	TOTAL VELOCITY OF MANEUVER
BT	X:XX (MIN:SEC)	MANEUVER DURATION
ΔVC	XXXX.X (fps)	PREMANEUVER ΔV SETTING IN EMS ΔV COUNTER
SXTS	XX (OCTAL)	SEXTANT STAR FOR MANEUVER ATTITUDE CK
SFT	XXX.X (DEG)	SEXTANT SHAFT SETTING FOR MANEUVER ATTITUDE CK
TRN	XX.X (DEG)	SEXTANT TRUNNION SETTING FOR MANEUVER ATTITUDE CK
BSS	XXX (OCTAL)	BORESIGHT STAR FOR MANEUVER ATTITUDE CK USING THE COAS
SPA	XX.X (DEG)	BSS PITCH ANGLE ON COAS
SXP	X.X (DEG)	BSS X POSITION ON COAS
LAT LONG	XX.XX XXX.XX	LATITUDE AND LONGITUDE OF THE LANDING POINT FOR ENTRY GUIDANCE
RTGO	XXXX.X	RANGE TO GO FOR EMS INITIALIZATION
VIO	XXXXXX (fps)	INERTIAL VELOCITY AT .05G FOR EMS INITIALIZATION
GET(.05G)	XX:XX:XX	TIME OF .05G
SET STARS		STARS FOR TELESCOPE FOR BACKUP GDC ALIGN
R, P, Y (ALIGN)		ATTITUDE TO BE SET IN ATTITUDE SET TW FOR BACKUP GDC ALIGN
ULLAGE		NO. OF SM RCS JETS USED AND LENGTH OF TIME OF USSAGE
HORIZON WINDOW		WINDOW MARKING AT WHICH HORIZON IS PLACED AT A SPECIFIED TIG (ATT CK)

P37 – RETURN TO EARTH

V37 Enter, 37 Enter

V06 N33 Flashing

Time of Ignition (h, min, 0.01 s)

V06 N60 Flashing

Blank, ΔV Desired, GAMMA EI Desired (ft/s, 0.01 deg)

V06 N61 Flashing

Impact Latitude and Longitude (0.01 deg, 0.01 deg)

V06 N39 Flashing

ΔT of Transfer (h, min, 0.01 s)

V06 N60 Flashing

Blank, V Predicted GAMMA EI (ft/s, 0.01 deg)

V06 N81 Flashing

ΔVX (LV), ΔVY (LV), ΔVZ (LV) at TIG (0.1 ft/s)

V04 N06 Flashing

R1: 0 0 0 0 7

R2: 0 0 0 0 X (1– SPS, 2–RCS)

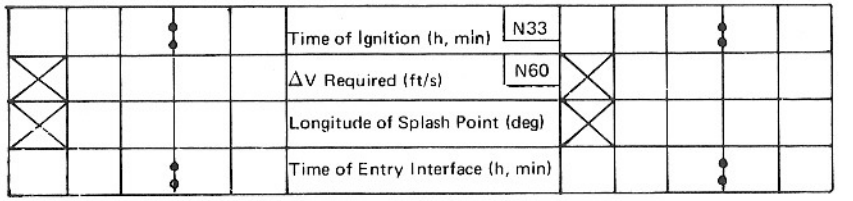
V06 N33 Flashing

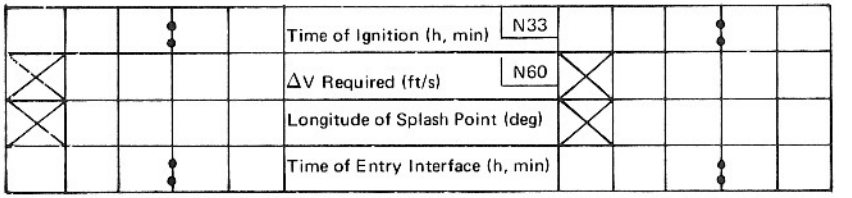
Time of Ignition (h, min, 0.01 s)

V16 N45 Flashing

Marks, TFI, Middle Gimbal Angle (marks, min/s, 0.01 deg)

L/O +8





P15 — TLI Initiate/Cutoff

V37 Enter, 15 Enter

V06N33 Flashing, GET of TB6 Initiation

V06N14 Flashing, Velocity Magnitude at S-IVB Cutoff

V06N95 TFI, Vg, VMAGI

+	0	0				Hours	N33	+	0	0				
+	0	0	0			Minutes GET		+	0	0	0			
+	0					Seconds of TB6		+	0					
+						VI/CO ft/s	N14	+						
			b			TFI min/s	N95				b			
						Vg ft/s								
						VMAGI ft/s								

NOTES

P47—THRUST MONITOR

V37 Enter, 47 Enter

CSM/LM Ejection

V16 N83 Flashing, ΔV XYZ Body Axes

N62 Enter

V16 N62 Flashing, Inertial Velocity, Altitude Rate, Altitude

X	X	X				R		X	X	X				
X	X	X				P	IMU Gimbal Angles (degrees)	X	X	X				
X	X	X				Y		X	X	X				
X	X	X				BT	(min:s)	X	X	X				
						VI	(ft/s)							
						X	N83							
						Y	ΔV ft/s							
						Z								
						V	ft/s N62							
						HDOT	ft/s							
						H	nmi							

NOTES:

P37 – RETURN TO EARTH

V37 Enter, 37 Enter
V06 N33 Flashing
Time of Ignition (h, min, 0.01 s)
V06 N60 Flashing
Blank, ΔV Desired, GAMMA EI Desired (ft/s, 0.01 deg)
V06 N61 Flashing
Impact Latitude and Longitude (0.01 deg, 0.01 deg)
V06 N39 Flashing
ΔT of Transfer (h, min, 0.01 s)
V06 N60 Flashing
Blank, V Predicted GAMMA EI (ft/s, 0.01 deg)
V06 N81 Flashing
ΔVX (LV), ΔVY (LV), ΔVZ (LV) at TIG (0.1 ft/s)
V04 N06 Flashing
R1: 0 0 0 0 7
R2: 0 0 0 0 X (1– SPS, 2–RCS)
V06 N33 Flashing
Time of Ignition (h, min, 0.01 s)
V16 N45 Flashing
Marks, TFI, Middle Gimbal Angle (marks, min/s, 0.01 deg)

L/O +15

		↓		Time of Ignition (h, min) N33			↓		
X				ΔV Required (ft/s) N60	X				
X				Longitude of Splash Point (deg)	X				
		↓		Time of Entry Interface (h, min)			↓		

		↓		Time of Ignition (h, min) N33			↓		
X				ΔV Required (ft/s) N60	X				
X				Longitude of Splash Point (deg)	X				
		↓		Time of Entry Interface (h, min)			↓		

P23–CISLUNAR MIDCOURSE NAVIGATION

V37 Enter, 23 Enter
V05 N70 Flashing
R1: 0 0 0 X X Celestial Body Code
R2: 0 0 X 0 0 0 – Horizon 1 – Earth Landmark 2 – Moon Landmark
R3: 0 0 C D 0 C = 0, D = 0 Landmark C-1 Earth Horizon C-2 Moon Horizon D-1 Near Horizon D-2 Far Horizon
V59 Flashing, Perform Optics Calibration
V51 Flashing - Please Mark

OPTICS CALIBRATION

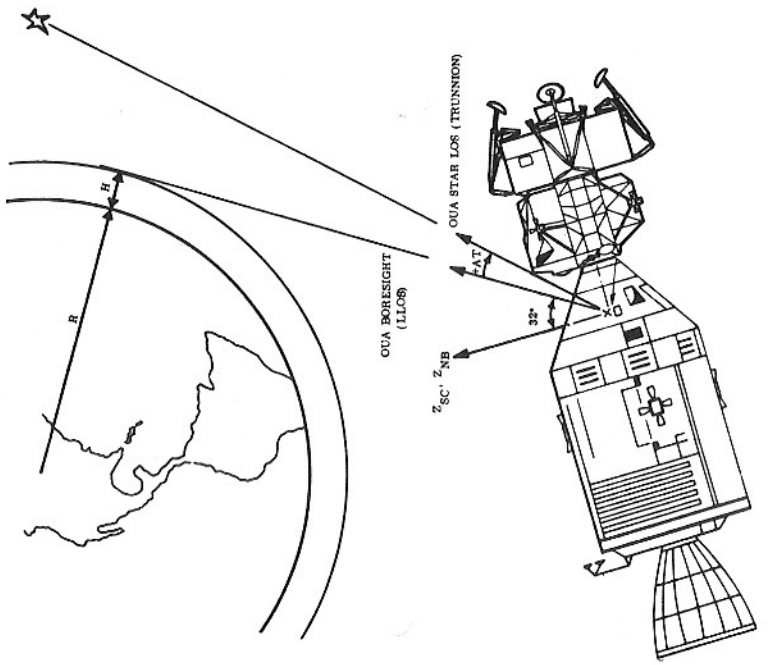
+	0	0				Hours		+	0	0			
+	0	0	0			Minutes GET		+	0	0	0		
+	0			↓		Seconds		+	0			↓	
X	0	0	0			Star ID	N70	X	0	0	0		
+			↓			Trun Angle Bias	N87 R2	+			↓		
+			↓			Trun Angle Bias	N87 R2	+			↓		
+			↓			Trun Angle Bias	N87 R2	+			↓		

MIDCOURSE NAVIGATION

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes GET		+	0	0	0		
+	0			↓		Seconds		+	0			↓	
X	0	0	0			Star ID	N70	X	0	0	0		
X	0	0		0	0	LMK ID		X	0	0		0	0
X	0	0			0	Hor ID		X	0	0			0
				↓		ΔR nmi	N49					↓	
				↓		ΔV ft/s						↓	
				↓		ΔR nmi	N49					↓	
				↓		ΔV ft/s						↓	
				↓		ΔR nmi	N49					↓	
				↓		ΔV ft/s						↓	
				↓		ΔR nmi	N49					↓	
				↓		ΔV ft/s						↓	
				↓		ΔR nmi	N49					↓	
				↓		ΔV ft/s						↓	
				↓		ΔR nmi	N49					↓	
				↓		ΔV ft/s						↓	

NOTES:

P23 — ASTRONAUT LOCATOR CALIBRATION



	H	H-UPDATE
APOLLO 8 LOVELL	32 KM	18 KM
APOLLO 10 YOUNG	24	24
APOLLO 11 COLLINS	24	35
APOLLO 12 GORDON	24	19
APOLLO 13 SWIGERT	24	10
APOLLO 14 ROOSA	28	NONE
APOLLO 15 WORDEN	28	NONE

P23—CISLUNAR MIDCOURSE NAVIGATION

V37 Enter, 23 Enter
V05 N70 Flashing
R1: 0 0 0 X X Celestial Body Code
R2: 0 0 X 0 0 0 — Horizon 1 — Earth Landmark 2 — Moon Landmark
R3: 0 0 C D 0 C = 0, D = 0 Landmark C-1 Earth Horizon C-2 Moon Horizon D-1 Near Horizon D-2 Far Horizon
V59 Flashing, Perform Optics Calibration
V51 Flashing - Please Mark

OPTICS CALIBRATION

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes GET		+	0	0	0		
+	0			•		Seconds		+	0			•	
X	0	0	0			Star ID	N70	X	0	0	0		
+			•			Trun Angle Bias	N87 R2	+			•		
+			•			Trun Angle Bias	N87 R2	+			•		
+			•			Trun Angle Bias	N87 R2	+			•		

MIDCOURSE NAVIGATION

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes GET		+	0	0	0		
+	0			•		Seconds		+	0			•	
X	0	0	0			Star ID	N70	X	0	0	0		
X	0	0		0	0	LMK ID		X	0	0		0	0
X	0	0			0	Hor ID		X	0	0			0
				•		ΔR nmi	N49					•	
				•		ΔV ft/s						•	
				•		ΔR nmi	N49					•	
				•		ΔV ft/s						•	
				•		ΔR nmi	N49					•	
				•		ΔV ft/s						•	
				•		ΔR nmi	N49					•	
				•		ΔV ft/s						•	
				•		ΔR nmi	N49					•	
				•		ΔV ft/s						•	
				•		ΔR nmi	N49					•	
				•		ΔV ft/s						•	

NOTES:

P30—EXTERNAL ΔV

MCC 1

V37 Enter, 30 Enter

V06 N33 Flashing, Load Desired GETI

V06 N81 Flashing, Load Desired ΔV

						Purpose							
			/			Prop/Guidance				/			
+						Weight (lb) N47	+						
	0	0				P_{Trim} N48		0	0				
	0	0				Y_{Trim} (degrees)		0	0				
+	0	0				Hours N33	+	0	0				
+	0	0	0			Minutes GETI	+	0	0	0			
+	0					Seconds	+	0					
						ΔV_X N81							
						ΔV_Y LV							
						ΔV_Z (ft/s)							
X	X	X				R	X	X	X				
X	X	X				P IMU Gimbal Angles (deg)	X	X	X				
X	X	X				Y	X	X	X				
+						H_{Apogee} N44	+						
						$H_{Perigee}$ nmi							
+						ΔVT (ft/s)	+						
X	X	X				BT (min:s)	X	X	X				
X						ΔVC (ft/s)	X						
X	X	X	X			SXT Star	X	X	X	X			
+					0	SFT (degrees)	+						0
+				0	0	TRN (degrees)	+					0	0
X	X	X				BSS (Coas Star)	X	X	X				
X	X					SPA (Coas Pitch, deg)	X	X					
X	X	X				SXP (Coas X Pos, deg)	X	X	X				
	0					LAT N61		0					
						LONG (degrees)							
+						RTGO (nmi) EMS	+						
+						VIO (ft/s)	+						
						GET 0.05 g Hr:min:s							
						SET STARS							
X	X	X				R_{Align}	X	X	X				
X	X	X				P_{Align}	X	X	X				
X	X	X				Y_{Align}	X	X	X				
						ULLAGE							

NOTES:

MCC 1

P40 — SPS THRUSTING CSM

V37 Enter, 40 Enter

V50 N18 Flashing, Request Maneuver to FDAI R, P, Y Angles

V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude

V50 N25 Flashing, R1 = 0 0 2 0 4, Gimbal Actuator Test Option

V06 N40, Time from Ignition, Velocity to be Gained, Measured Change in Velocity

V99 N40 Flashing, Engine On Enable Request

V06 N40, Time from Cutoff, Velocity to be Gained, Measured Change in Velocity

V16 N40 Flashing, Final Values at Engine Cutoff

V16 N85 Flashing, Body Axes Residuals (to be Nulled)

V37 Flashing, V82 Enter

V16 N44 Flashing, Apogee Altitude, Perigee Altitude, Time to Freefall to 35 K ft Moon Orbit, 300 K ft Earth Orbit

						50-18	Roll
							Pitch (deg)
							Yaw
						06-18	Roll
							Pitch (deg)
							Yaw
		X				06-40	TFI (min:s)
							VG (ft/s)
							ΔVM (ft/s)
		X				06-40	TFC (min:s)
							VG (ft/s)
							ΔVM (ft/s)
		X				16-40	TFC (min:s)
							VG (ft/s)
							ΔVM (ft/s)
						85	X
							Y Residuals (ft/s)
							Z
						85	X
							Y TRIM (ft/s)
							Z
						44	HA (nmi)
							HP (nmi)
		X					TFF (min:s)

P41 — RCS THRUSTING

V37 Enter, 41 Enter

V50 N18 Flashing, Request Maneuver to FDAI R, P, Y, Angles

V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude

V06 N85, X, Y, Z Body Axes Velocity to be Gained

V16 N85 (Average G on at TIG -30) Velocity to be Gained

V16 N85 Flashing, Body Axes Residuals (to be Nulled)

						50-18	Roll
							Pitch (deg)
							Yaw
						06-18	Roll
							Pitch (deg)
							Yaw
						06-85	X
							Y VG (ft/s)
							Z
						16-85	X
							Y VG (ft/s)
							Z
						16-85	X
							Y Residuals (ft/s)
							Z
							X
							Y Trim (ft/s)
							Z

P37 — RETURN TO EARTH

V37 Enter, 37 Enter
V06 N33 Flashing
Time of Ignition (h, min, 0.01 s)
V06 N60 Flashing
Blank, ΔV Desired, GAMMA EI Desired (ft/s, 0.01 deg)
V06 N61 Flashing
Impact Latitude and Longitude (0.01 deg, 0.01 deg)
V06 N39 Flashing
ΔT of Transfer (h, min, 0.01 s)
V06 N60 Flashing
Blank, V Predicted GAMMA EI (ft/s, 0.01 deg)
V06 N81 Flashing
ΔVX (LV), ΔVY (LV), ΔVZ (LV) at TIG (0.1 ft/s)
V04 N06 Flashing
R1: 00007
R2: 0000X (1—SPS, 2—RCS)
V06 N33 Flashing
Time of Ignition (h, min, 0.01 s)
V16 N45 Flashing
Marks, TFI, Middle Gimbal Angle (marks, min/s, 0.01 deg)

L/O +25 / L/O +35

Time of Ignition (h, min) N33	
ΔV Required (ft/s) N60	
Longitude of Splash Point (deg)	
Time of Entry Interface (h, min)	

L/O +45 / L/O +55

Time of Ignition (h, min) N33	
ΔV Required (ft/s) N60	
Longitude of Splash Point (deg)	
Time of Entry Interface (h, min)	

P30—EXTERNAL ΔV
MCC 2

V37 Enter, 30 Enter
V06 N33 Flashing, Load Desired GETI
V06 N81 Flashing, Load Desired ΔV

						Purpose								
		/				Prop/Guidance			/					
+						Weight (lb)	N47	+						
	0	0				P_{Trim}	N48		0	0				
	0	0				Y_{Trim} (degrees)			0	0				
+	0	0				Hours	N33	+	0	0				
+	0	0	0			Minutes GETI		+	0	0	0			
+	0					Seconds		+	0					
						ΔV_X	N81							
						ΔV_Y LV								
						ΔV_Z (ft/s)								
X	X	X				R		X	X	X				
X	X	X				P IMU Gimbal Angles (deg)		X	X	X				
X	X	X				Y		X	X	X				
+						H_{Apogee}	N44	+						
						$H_{Perigee}$ nmi								
+						ΔVT (ft/s)		+						
X	X	X				BT (min:s)		X	X	X				
X						ΔVC (ft/s)		X						
X	X	X	X			SXT Star		X	X	X	X			
+					0	SFT (degrees)		+					0	
+				0	0	TRN (degrees)		+				0	0	
X	X	X				BSS (Coas Star)		X	X	X				
X	X					SPA (Coas Pitch, deg)		X	X					
X	X	X				SXP (Coas X Pos, deg)		X	X	X				
	0					LAT	N61		0					
						LONG (degrees)								
+						RTGO (nmi) EMS		+						
+						VIO (ft/s)		+						
						GET 0.05 g Hr:min:s								
						SET STARS								
X	X	X				R_{Align}		X	X	X				
X	X	X				P_{Align}		X	X	X				
X	X	X				Y_{Align}		X	X	X				
						ULLAGE								

NOTES:

P40 -- SPS THRUSTING CSM

MCC 2

V37 Enter, 40 Enter
V50 N18 Flashing, Request Maneuver to FDAI R, P, Y Angles
V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude
V50 N25 Flashing, R1 = 0 0 2 0 4, Gimbal Actuator Test Option
V06 N40, Time from Ignition, Velocity to be Gained, Measured Change in Velocity
V99 N40 Flashing, Engine On Enable Request
V06 N40, Time from Cutoff, Velocity to be Gained, Measured Change in Velocity
V16 N40 Flashing, Final Values at Engine Cutoff
V16 N85 Flashing, Body Axes Residuals (to be Nulled)
V37 Flashing, V82 Enter
V16 N44 Flashing, Apogee Altitude, Perigee Altitude, Time to Freefall to 35 K ft Moon Orbit, 300 K ft Earth Orbit

50-18	Roll
	Pitch (deg)
	Yaw
06-18	Roll
	Pitch (deg)
	Yaw
06-40	TFI (min:s)
	VG (ft/s)
	ΔVM (ft/s)
06-40	TFC (min:s)
	VG (ft/s)
	ΔVM (ft/s)
16-40	TFC (min:s)
	VG (ft/s)
	ΔVM (ft/s)
85	X
	Y Residuals (ft/s)
	Z
85	X
	Y TRIM (ft/s)
	Z
44	HA (nmi)
	HP (nmi)
	TFF (min:s)

P41 -- RCS THRUSTING

V37 Enter, 41 Enter
V50 N18 Flashing, Request Maneuver to FDAI R, P, Y, Angles
V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude
V06 N85, X, Y, Z Body Axes Velocity to be Gained
V16 N85 (Average G on at TIG -30) Velocity to be Gained
V16 N85 Flashing, Body Axes Residuals (to be Nulled)

50-18	Roll
	Pitch (deg)
	Yaw
06-18	Roll
	Pitch (deg)
	Yaw
06-85	X
	Y VG (ft/s)
	Z
16-85	X
	Y VG (ft/s)
	Z
16-85	X
	Y Residuals (ft/s)
	Z
	X
	Y Trim (ft/s)
	Z

P30--EXTERNAL ΔV

MCC 3

V37 Enter, 30 Enter
V06 N33 Flashing, Load Desired GETI
V06 N81 Flashing, Load Desired ΔV

						Purpose								
		/				Prop/Guidance				/				
+						Weight (lb)	N47	+						
	0	0				P_{Trim}	N48		0	0				
	0	0				Y_{Trim} (degrees)			0	0				
+	0	0				Hours	N33	+	0	0				
+	0	0	0			Minutes GETI		+	0	0	0			
+	0					Seconds		+	0					
						ΔV_X	N81							
						ΔV_Y LV								
						ΔV_Z (ft/s)								
X	X	X				R		X	X	X				
X	X	X				P IMU Gimbal Angles (deg)		X	X	X				
X	X	X				Y		X	X	X				
+						H_{Apogee}	N44	+						
						$H_{Perigee}$ nmi								
+						ΔVT (ft/s)		+						
X	X	X				BT (min:s)		X	X	X				
X						ΔVC (ft/s)		X						
X	X	X	X			SXT Star		X	X	X	X			
+					0	SFT (degrees)		+					0	
+				0	0	TRN (degrees)		+				0	0	
X	X	X				BSS (Coas Star)		X	X	X				
X	X					SPA (Coas Pitch, deg)		X	X					
X	X	X				SXP (Coas X Pos, deg)		X	X	X				
	0					LAT (degrees)	N61		0					
						LONG								
+						RTGO (nmi) EMS		+						
+						VIO (ft/s)		+						
						GET 0.05 g Hr:min:s								
						SET STARS								
X	X	X				R_{Align}		X	X	X				
X	X	X				P_{Align}		X	X	X				
X	X	X				Y_{Align}		X	X	X				
						ULLAGE								

NOTES:

MCC 3

P40 -- SPS THRUSTING CSM

V37 Enter, 40 Enter
V50 N18 Flashing, Request Maneuver to FDAI R, P, Y Angles
V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude
V50 N25 Flashing, R1 = 0 0 2 0 4, Gimbal Actuator Test Option
V06 N40, Time from Ignition, Velocity to be Gained, Measured Change in Velocity
V99 N40 Flashing, Engine On Enable Request
V06 N40, Time from Cutoff, Velocity to be Gained, Measured Change in Velocity
V16 N40 Flashing, Final Values at Engine Cutoff
V16 N85 Flashing, Body Axes Residuals (to be Nulled)
V37 Flashing, V82 Enter
V16 N44 Flashing, Apogee Altitude, Perigee Altitude, Time to Freefall to 35 K ft Moon Orbit, 300 K ft Earth Orbit

						50-18	Roll
							Pitch (deg)
							Yaw
						06-18	Roll
							Pitch (deg)
							Yaw
			X			06-40	TFI (min:s)
							VG (ft/s)
							ΔVM (ft/s)
			X			06-40	TFC (min:s)
							VG (ft/s)
							ΔVM (ft/s)
			X			16-40	TFC (min:s)
							VG (ft/s)
							ΔVM (ft/s)
						85	X
							Y Residuals (ft/s)
							Z
						85	X
							Y TRIM (ft/s)
							Z
						44	HA (nmi)
							HP (nmi)
			X				TFF (min:s)

P41 -- RCS THRUSTING

V37 Enter, 41 Enter
V50 N18 Flashing, Request Maneuver to FDAI R, P, Y, Angles
V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude
V06 N85, X, Y, Z Body Axes Velocity to be Gained
V16 N85 (Average G on at TIG -30) Velocity to be Gained
V16 N85 Flashing, Body Axes Residuals (to be Nulled)

						50-18	Roll
							Pitch (deg)
							Yaw
						06-18	Roll
							Pitch (deg)
							Yaw
						06-85	X
							Y VG (ft/s)
							Z
						16-85	X
							Y VG (ft/s)
							Z
						16-85	X
							Y Residuals (ft/s)
							Z
							X
							Y Trim (ft/s)
							Z

P30--EXTERNAL ΔV
MCC-4 & PERICYNTHION + 2HR

V37 Enter, 30 Enter
V06 N33 Flashing, Load Desired GETI
V06 N81 Flashing, Load Desired ΔV

						Purpose						
			/			Prop/Guidance			/			
+						Weight (lb)	N47	+				
	0	0				P_{Trim}	N48		0	0		
	0	0				Y_{Trim} (degrees)			0	0		
+	0	0				Hours	N33	+	0	0		
+	0	0	0			Minutes GETI		+	0	0	0	
+	0					Seconds		+	0			
						ΔV_X	N81					
						ΔV_Y LV						
						ΔV_Z (ft/s)						
X	X	X				R		X	X	X		
X	X	X				P IMU Gimbal Angles (deg)		X	X	X		
X	X	X				Y		X	X	X		
+						H_{Apogee}	N44	+				
						$H_{Perigee}$ nmi						
+						ΔVT (ft/s)		+				
X	X	X				BT (min:s)		X	X	X		
X						ΔVC (ft/s)		X				
X	X	X	X			SXT Star		X	X	X	X	
+					0	SFT (degrees)		+				0
+				0	0	TRN (degrees)		+			0	0
X	X	X				BSS (Coas Star)		X	X	X		
X	X					SPA (Coas Pitch, deg)		X	X			
X	X	X				SXP (Coas X Pos, deg)		X	X	X		
	0					LAT	N61		0			
						LONG (degrees)						
+						RTGO (nmi) EMS		+				
+						VIO (ft/s)		+				
						GET 0.05 g Hr:min:s						
						SET STARS						
X	X	X				R_{Align}		X	X	X		
X	X	X				P_{Align}		X	X	X		
X	X	X				Y_{Align}		X	X	X		
						ULLAGE						

NOTES:

MCC 4

P40 — SPS THRUSTING CSM

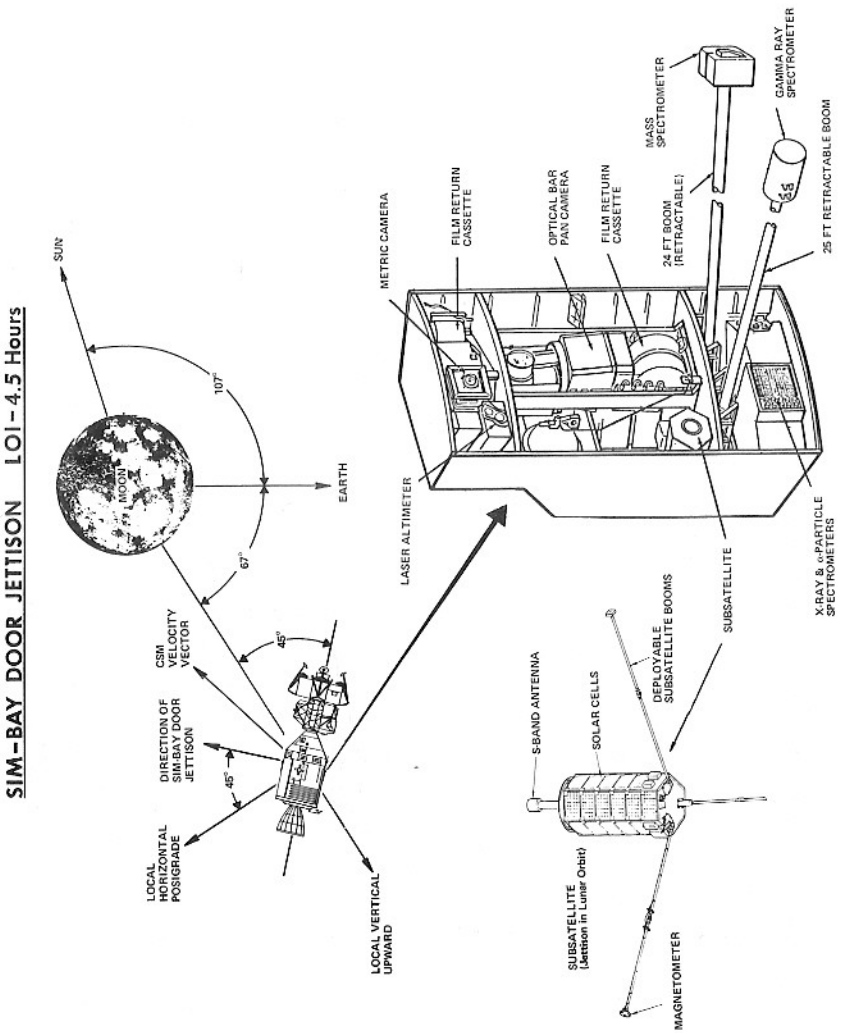
V37 Enter, 40 Enter
V50 N18 Flashing, Request Maneuver to FDAI R, P, Y Angles
V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude
V50 N25 Flashing, R1 = 0 0 2 0 4, Gimbal Actuator Test Option
V06 N40, Time from Ignition, Velocity to be Gained, Measured Change in Velocity
V99 N40 Flashing, Engine On Enable Request
V06 N40, Time from Cutoff, Velocity to be Gained, Measured Change in Velocity
V16 N40 Flashing, Final Values at Engine Cutoff
V16 N85 Flashing, Body Axes Residuals (to be Nulled)
V37 Flashing, V82 Enter
V16 N44 Flashing, Apogee Altitude, Perigee Altitude, Time to Freefall to 35 K ft Moon Orbit, 300 K ft Earth Orbit

50-18	Roll
	Pitch (deg)
	Yaw
06-18	Roll
	Pitch (deg)
	Yaw
06-40	TFI (min:s)
	VG (ft/s)
	ΔVM (ft/s)
06-40	TFC (min:s)
	VG (ft/s)
	ΔVM (ft/s)
16-40	TFC (min:s)
	VG (ft/s)
	ΔVM (ft/s)
85	X
	Y Residuals (ft/s)
	Z
85	X
	Y TRIM (ft/s)
	Z
44	HA (nmi)
	HP (nmi)
	TFF (min:s)

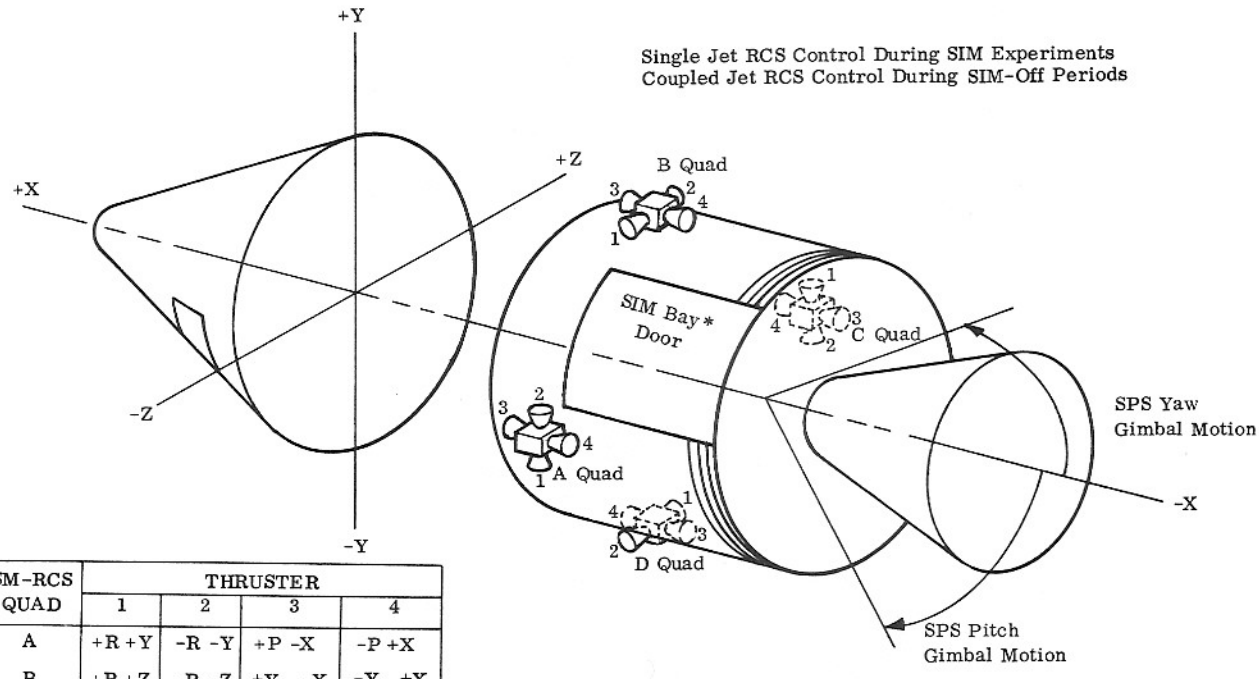
P41 — RCS THRUSTING

V37 Enter, 41 Enter
V50 N18 Flashing, Request Maneuver to FDAI R, P, Y, Angles
V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude
V06 N85, X, Y, Z Body Axes Velocity to be Gained
V16 N85 (Average G on at TIG -30) Velocity to be Gained
V16 N85 Flashing, Body Axes Residuals (to be Nulled)

50-18	Roll
	Pitch (deg)
	Yaw
06-18	Roll
	Pitch (deg)
	Yaw
06-85	X
	Y VG (ft/s)
	Z
16-85	X
	Y VG (ft/s)
	Z
16-85	X
	Y Residuals (ft/s)
	Z
X	
Y	Trim (ft/s)
Z	



RCS THRUSTER CONSTRAINTS FOR SIM EXPERIMENTS



Single Jet RCS Control During SIM Experiments
Coupled Jet RCS Control During SIM-Off Periods

SM-RCS QUAD	THRUSTER			
	1	2	3	4
A	+R +Y	-R -Y	+P -X	-P +X
B	+R +Z	-R -Z	$+Y_W$ -X	$-Y_W$ +X
C	+R -Y	-R +Y	+P +X	-P -X
D	+R -Z	-R +Z	$+Y_W$ +X	$-Y_W$ -X

*Use of Thrusters A2, A4, B1 and B4 is constrained when SIM experiments are in process.
Use of Quads A and B is constrained by CSM EVA to retrieve film cassettes from SIM Bay.

P30–EXTERNAL ΔV
LOI (Preliminary) & TEI 4

V37 Enter, 30 Enter
V06 N33 Flashing, Load Desired GETI
V06 N81 Flashing, Load Desired ΔV

						Purpose							
		/				Prop/Guidance				/			
+						Weight (lb)	N47	+					
	0	0				P_{Trim} (degrees)	N48		0	0			
	0	0				Y_{Trim}			0	0			
+	0	0				Hours	N33	+	0	0			
+	0	0	0			Minutes GETI		+	0	0	0		
+	0					Seconds		+	0				
						ΔV_X	N81						
						ΔV_Y LV							
						ΔV_Z (ft/s)							
X	X	X				R		X	X	X			
X	X	X				P IMU Gimbal Angles (deg)		X	X	X			
X	X	X				Y		X	X	X			
+						H_{Apogee} nmi	N44	+					
						$H_{Perigee}$							
+						ΔVT (ft/s)		+					
X	X	X				BT (min:s)		X	X	X			
X						ΔVC (ft/s)		X					
X	X	X	X			SXT Star		X	X	X	X		
+					0	SFT (degrees)		+					0
+				0	0	TRN (degrees)		+				0	0
X	X	X				BSS (Coas Star)		X	X	X			
X	X					SPA (Coas Pitch, deg)		X	X				
X	X	X				SXP (Coas X Pos, deg)		X	X	X			
	0					LAT (degrees)	N61		0				
						LONG							
+						RTGO (nmi) EMS		+					
+						VIO (ft/s)		+					
						GET 0.05 g Hr:min:s							
						SET STARS							
X	X	X				R_{Align}		X	X	X			
X	X	X				P_{Align}		X	X	X			
X	X	X				Y_{Align}		X	X	X			
						ULLAGE							

NOTES:

P30–EXTERNAL ΔV

LOI

V37 Enter, 30 Enter

V06 N33 Flashing, Load Desired GETI

V06 N81 Flashing, Load Desired ΔV

						Purpose								
			/			Prop/Guidance				/				
+						Weight (lb) N47	+							
	0	0				P_{Trim} N48		0	0					
	0	0				Y_{Trim} (degrees)		0	0					
+	0	0				Hours N33	+	0	0					
+	0	0	0			Minutes GETI	+	0	0	0				
+	0					Seconds	+	0						
						ΔV_X N81								
						ΔV_Y LV								
						ΔV_Z (ft/s)								
X	X	X				R	X	X	X					
X	X	X				P IMU Gimbal Angles (deg)	X	X	X					
X	X	X				Y	X	X	X					
+						H_{Apogee} N44	+							
						$H_{Perigee}$ nmi								
+						ΔVT (ft/s)	+							
X	X	X				BT (min:s)	X	X	X					
X						ΔVC (ft/s)	X							
X	X	X	X			SXT Star	X	X	X	X				
+					0	SFT (degrees)	+					0		
+				0	0	TRN (degrees)	+				0	0		
X	X	X				BSS (Coas Star)	X	X	X					
X	X					SPA (Coas Pitch, deg)	X	X						
X	X	X				SXP (Coas X Pos, deg)	X	X	X					
	0					LAT N61		0						
						LONG (degrees)								
+						RTGO (nmi) EMS	+							
+						VIO (ft/s)	+							
						GET 0.05 g Hr:min:s								
						SET STARS								
X	X	X				R_{Align}	X	X	X					
X	X	X				P_{Align}	X	X	X					
X	X	X				Y_{Align}	X	X	X					
						ULLAGE								

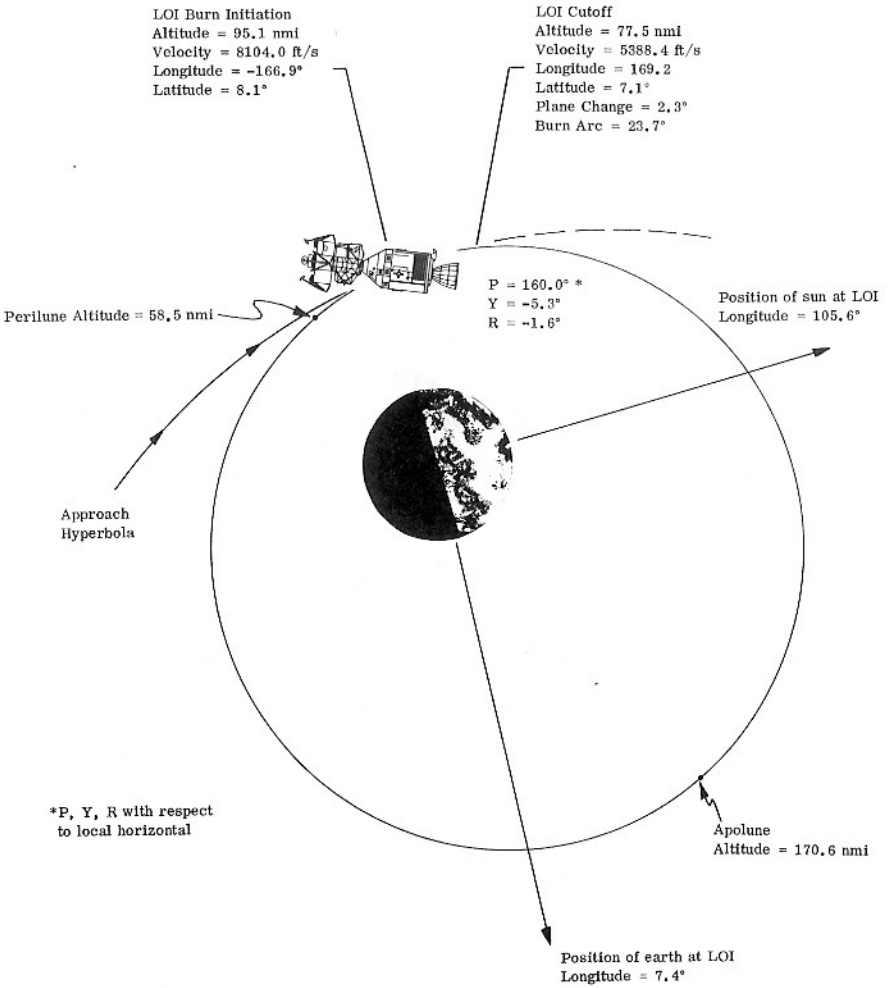
NOTES:

LUNAR ORBIT INSERTION

EVENT	BT/ΔV	G.E.T.	PROPULSION/ GUIDANCE	PRETHRUST TARGETING
LOI (RETROGRADE)	375/2807.0	74:28:38.6	SPS/G&N EXT Δ V (P-40)	P-30

						ΔV_X N85	+	x	x				h	
						ΔV_Y RESIDUALS (ft/s)	+	x	x	x			min	GET
						ΔV_Z (BODY AXIS)	+	x					s	

— — —•— $V_{X_{TRIM}}$ — — —•— $V_{Y_{TRIM}}$ — — —•— $V_{Z_{TRIM}}$ (ft/s)



P30–EXTERNAL ΔV
TEI 5 & DOI

V37 Enter, 30 Enter

V06 N33 Flashing, Load Desired GETI

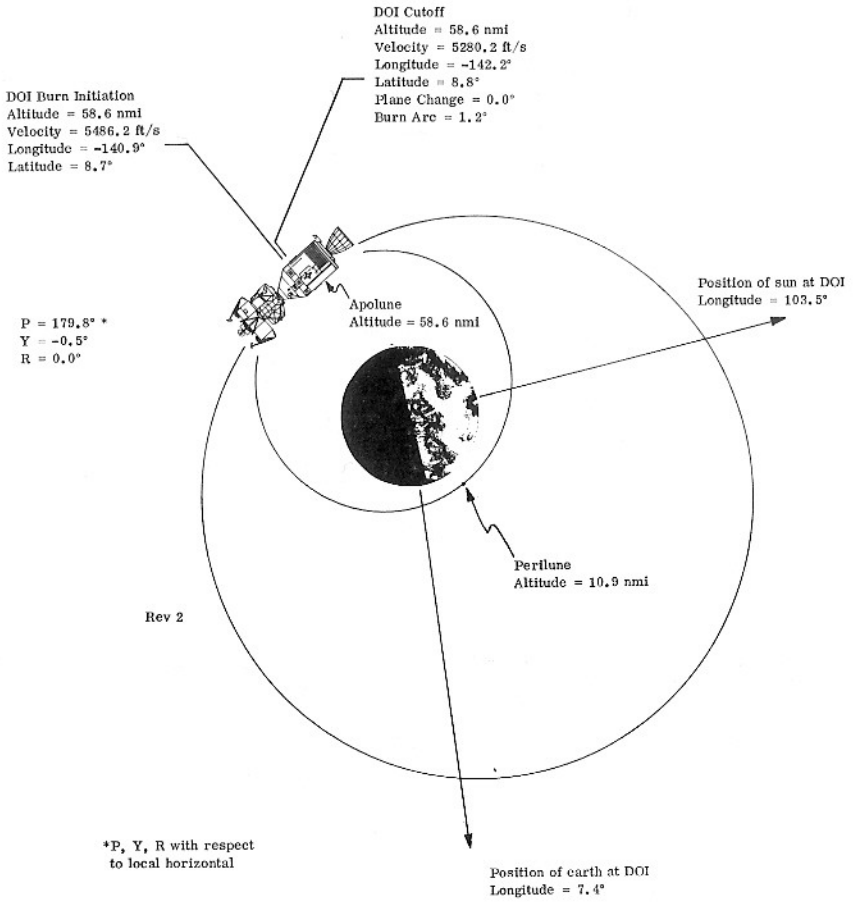
V06 N81 Flashing, Load Desired ΔV

						Purpose								
			/			Prop/Guidance				/				
+						Weight (lb) N47	+							
	0	0				P_{Trim} N48		0	0					
	0	0				Y_{Trim} (degrees)		0	0					
+	0	0				Hours N33	+	0	0					
+	0	0	0			Minutes GETI	+	0	0	0				
+	0					Seconds	+	0						
						ΔV_X N81								
						ΔV_Y LV								
						ΔV_Z (ft/s)								
X	X	X				R	X	X	X					
X	X	X				P IMU Gimbal Angles (deg)	X	X	X					
X	X	X				Y	X	X	X					
+						H_{Apogee} N44	+							
						$H_{Perigee}$ nmi								
+						ΔVT (ft/s)	+							
X	X	X				BT (min:s)	X	X	X					
X						ΔVC (ft/s)	X							
X	X	X	X			SXT Star	X	X	X	X				
+					0	SFT (degrees)	+					0		
+				0	0	TRN (degrees)	+				0	0		
X	X	X				BSS (Coas Star)	X	X	X					
X	X					SPA (Coas Pitch, deg)	X	X						
X	X	X				SXP (Coas X Pos, deg)	X	X	X					
	0					LAT N61		0						
						LONG (degrees)								
+						RTGO (nmi) EMS	+							
+						VIO (ft/s)	+							
		/		/		GET 0.05 g Hr:min:s		/			/			
						SET STARS								
X	X	X				R_{Align}	X	X	X					
X	X	X				P_{Align}	X	X	X					
X	X	X				Y_{Align}	X	X	X					
						ULLAGE								

NOTES:

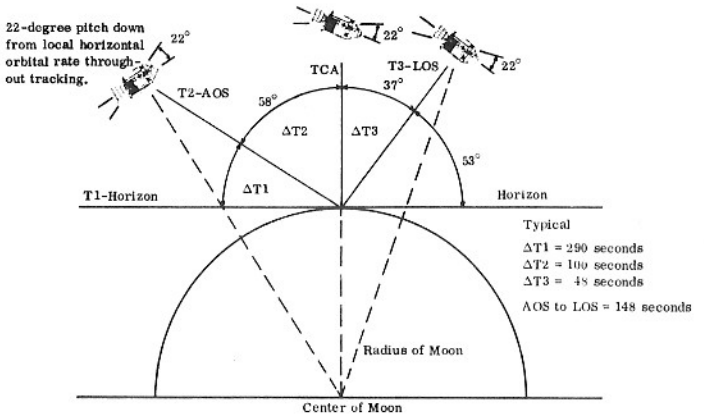
DESCENT ORBIT INITIATION

EVENT	BT/ΔV	G.E.T.	PROPULSION/ GUIDANCE	PRETHRUST TARGETING
DOI (RETROGRADE)	24.1/206.0	78:35:30.3	SPS/G&N EXT Δ V (P-40)	P-30
	ΔV_X N85		+ x x	h
	ΔV_y RESIDUALS (ft/s)		+ x x x	min GET
	ΔV_z (BODY AXIS)		+ x	s
$V_{x_{TRIM}}$	$V_{y_{TRIM}}$		$V_{z_{TRIM}}$ (ft/s)	



P24 — LANDMARK TRACKING

CSM Landmark Tracking Profile



TGT: ( )

T_1 __ __ __:__ __:__ __

T_2 __ __ __:__ __:__ __

TCA __ __ __:__ __:__ __

T_3 __ __ __:__ __:__ __

R __ __ __ °P __ __ __ °Y __ __ __ ° (T2 ACQ)

N or S nmi __ __ / SA __ __ TA __ __ (T2 ACQ)

N89 LAT __ __.__ __ __

LONG/2 __ __.__ __ __

ALT __ __ __.__ __

TGT: ( )

T_1 __ __ __:__ __:__ __

T_2 __ __ __:__ __:__ __

TCA __ __ __:__ __:__ __

T_3 __ __ __:__ __:__ __

R __ __ __ °P __ __ __ °Y __ __ __ ° (T2 ACQ)

N or S nmi __ __ / SA __ __ TA __ __ (T2 ACQ)

N89 LAT __ __.__ __ __

LONG/2 __ __.__ __ __

ALT __ __ __.__ __

P24 RATE-AIDED OPTICS TRACKING

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

V37E 24E

F 06 89 LAT, LONG/2, ALT (0.001°, 0.001°, 0.01 nmi)
LOAD LMK COORDS
OPT ZERO - OFF
PRO

06 92 AUTO OPT SHF/TRUN (0.01°, 0.001°)
- F 05 09 00404 (TRUN > 90°)
- MNVR to acquire
- PRO
- or V34E, F 37

OPTICS MODE - MAN

F 51 MARK REQUEST
MARK (as often as desired)
To terminate:
PRO

F 37 XXE
OPT ZERO - ZERO

P24 — LANDMARK TRACKING
MARK DATA

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes	GET	+	0	0	0		
+	0			•		Seconds		+	0			•	
+				•		P		+				•	
+				•		Y	IMU Gimbal Angles (degree)	+				•	
+				•		R		+				•	
+				•		Shaft	SXT Angles (degree)	+				•	
+			•			Trunnion		+		•			

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes	GET	+	0	0	0		
+	0			•		Seconds		+	0			•	
+				•		P		+				•	
+				•		Y	IMU Gimbal Angles (degree)	+				•	
+				•		R		+				•	
+				•		Shaft	SXT Angles (degree)	+				•	
+			•			Trunnion		+		•			

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes	GET	+	0	0	0		
+	0			•		Seconds		+	0			•	
+				•		P		+				•	
+				•		Y	IMU Gimbal Angles (degree)	+				•	
+				•		R		+				•	
+				•		Shaft	SXT Angles (degree)	+				•	
+			•			Trunnion		+		•			

NOTES:

P30–EXTERNAL ΔV
TEI 12 & TEI 19

V37 Enter, 30 Enter

V06 N33 Flashing, Load Desired GETI

V06 N81 Flashing, Load Desired ΔV

						Purpose							
		/				Prop/Guidance			/				
+						Weight (lb) N47	+						
	0	0				P_{Trim} N48		0	0				
	0	0				Y_{Trim} (degrees)		0	0				
+	0	0				Hours N33	+	0	0				
+	0	0	0			Minutes GETI	+	0	0	0			
+	0					Seconds	+	0					
						ΔV_X N81							
						ΔV_Y LV							
						ΔV_Z (ft/s)							
X	X	X				R	X	X	X				
X	X	X				P IMU Gimbal Angles (deg)	X	X	X				
X	X	X				Y	X	X	X				
+						H_{Apogee} N44	+						
						$H_{Perigee}$ nmi							
+						ΔVT (ft/s)	+						
X	X	X				BT (min:s)	X	X	X				
X						ΔVC (ft/s)	X						
X	X	X	X			SXT Star	X	X	X	X			
+					0	SFT (degrees)	+						0
+				0	0	TRN (degrees)	+					0	0
X	X	X				BSS (Coas Star)	X	X	X				
X	X					SPA (Coas Pitch, deg)	X	X					
X	X	X				SXP (Coas X Pos, deg)	X	X	X				
	0					LAT N61 (degrees)		0					
						LONG							
+						RTGO (nmi) EMS	+						
+						VIO (ft/s)	+						
						GET 0.05 g Hr:min:s							
						SET STARS							
X	X	X				R_{Align}	X	X	X				
X	X	X				P_{Align}	X	X	X				
X	X	X				Y_{Align}	X	X	X				
						ULLAGE							

NOTES:

P30–EXTERNAL ΔV
Separation

V37 Enter, 30 Enter

V06 N33 Flashing, Load Desired GETI

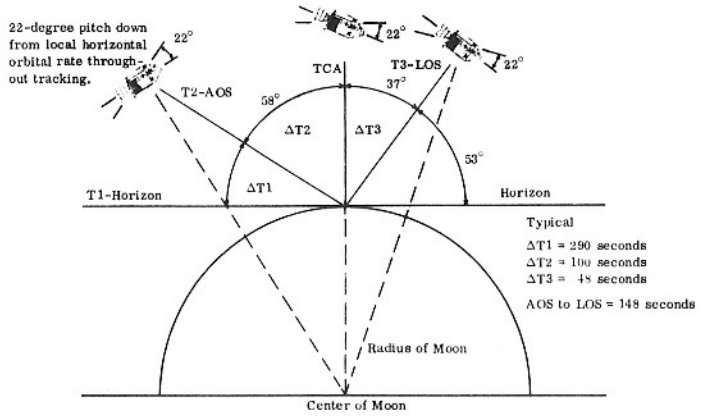
V06 N81 Flashing, Load Desired ΔV

						Purpose							
		/				Prop/Guidance			/				
+						Weight (lb) N47	+						
	0	0				P_{Trim} N48		0	0				
	0	0				Y_{Trim} (degrees)		0	0				
+	0	0				Hours N33	+	0	0				
+	0	0	0			Minutes GETI	+	0	0	0			
+	0					Seconds	+	0					
						ΔV_X N81							
						ΔV_Y LV							
						ΔV_Z (ft/s)							
X	X	X				R	X	X	X				
X	X	X				P IMU Gimbal Angles (deg)	X	X	X				
X	X	X				Y	X	X	X				
+						H_{Apogee} N44	+						
						$H_{Perigee}$ nmi							
+						ΔVT (ft/s)	+						
X	X	X				BT (min:s)	X	X	X				
X						ΔVC (ft/s)	X						
X	X	X	X			SXT Star	X	X	X	X			
+					0	SFT (degrees)	+						0
+				0	0	TRN (degrees)	+					0	0
X	X	X				BSS (Coas Star)	X	X	X				
X	X					SPA (Coas Pitch, deg)	X	X					
X	X	X				SXP (Coas X Pos, deg)	X	X	X				
	0					LAT N61 (degrees)		0					
						LONG							
+						RTGO (nmi) EMS	+						
+						VIO (ft/s)	+						
						GET 0.05 g Hr:min:s							
						SET STARS							
X	X	X				R_{Align}	X	X	X				
X	X	X				P_{Align}	X	X	X				
X	X	X				Y_{Align}	X	X	X				
						ULLAGE							

NOTES:

P24 – LANDMARK TRACKING

CSM Landmark Tracking Profile



TGT: ( )

T_1 _ _ _ : _ _ : _ _

T_2 _ _ _ : _ _ : _ _

TCA _ _ _ : _ _ : _ _

T_3 _ _ _ : _ _ : _ _

R _ _ _ ° P _ _ _ ° Y _ _ _ ° (T2 ACQ)

N or S nmi _ _ / SA _ _ _ TA _ _ _ (T2 ACQ)

N89 LAT _ _ _ . _ _ _

LONG/2 _ _ _ . _ _ _

ALT _ _ _ _ . _ _

TGT: ( )

T_1 _ _ _ : _ _ : _ _

T_2 _ _ _ : _ _ : _ _

TCA _ _ _ : _ _ : _ _

T_3 _ _ _ : _ _ : _ _

R _ _ _ ° P _ _ _ ° Y _ _ _ ° (T2 ACQ)

N or S nmi _ _ / SA _ _ _ TA _ _ _ (T2 ACQ)

N89 LAT _ _ _ . _ _ _

LONG/2 _ _ _ . _ _ _

ALT _ _ _ _ . _ _

P24 RATE-AIDED OPTICS TRACKING

CMC – on (req)
ISS – on and aligned
SCS – on
BMAG MODE (3) – RATE 2
G&N PWR OPTICS – on
OPT ZERO – ZERO (verify)
OPT MODE – CMC

V37E 24E

F 06 89 LAT, LONG/2, ALT (0.001°, 0.001°, 0.01 nmi)
LOAD LMK COORDS
OPT ZERO – OFF
PRO

06 92 AUTO OPT SHF/TRUN (0.01°, 0.001°)
- F 05 09 00404 (TRUN >90°)
- MNVR to acquire
- PRO
- or V34E, F 37

OPTICS MODE – MAN

F 51 MARK REQUEST
MARK (as often as desired)
To terminate:
PRO

F 37 XXE
OPT ZERO – ZERO

P24 – LANDMARK TRACKING
MARK DATA

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes	GET	+	0	0	0		
+	0					Seconds		+	0				
+						P		+					
+						Y	IMU Gimbal Angles (degree)	+					
+						R		+					
+						Shaft		+					
+						Trunnion	SXT Angles (degree)	+					

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes	GET	+	0	0	0		
+	0					Seconds		+	0				
+						P		+					
+						Y	IMU Gimbal Angles (degree)	+					
+						R		+					
+						Shaft		+					
+						Trunnion	SXT Angles (degree)	+					

+	0	0				Hours		+	0	0			
+	0	0	0			Minutes	GET	+	0	0	0		
+	0					Seconds		+	0				
+						P		+					
+						Y	IMU Gimbal Angles (degree)	+					
+						R		+					
+						Shaft		+					
+						Trunnion	SXT Angles (degree)	+					

NOTES:

LM DOCKED ALIGNMENT

Docking Tunnel Index Angle:

R_c = _____ deg. (Recorded during 1st IVT to LM
Verified during succeeding IVT's)

Docked Coarse Align:

1. CSM should be in Min. Deadband, Attitude Hold.

2. CMP executes V06N20E and reports ICDU angles.

3. CDR calculates coarse align angles:

Outer Gimbal	Inner Gimbal	Middle Gimbal
300.00°	180.00°	360.00°
+_____._____ R_c		
-_____._____ X_{cm}	+_____._____ Y_{cm}	-_____._____ Z_{cm}
=_____._____ X_{lm}	=_____._____ Y_{lm}	=_____._____ Z_{lm}

4. CDR executes V41N20E and loads X, Y, Z CDU angles.

5. CDR executes V40N20E -- IMU goes inertial.

NOTE: The accuracy of this procedure is limited by
(a) the coarse align accuracy of the ISS
(b) vehicle attitude changes between steps 2 and 5.

Docked Fine Align:

6. CMP and CDR enter simultaneous V06N20 in CM and LM. The ICDU angles are recorded and reported to MCC.

GET = _____:_____:_____ (for gyro drift calculation)

	Outer Gimbal	Inner Gimbal	Middle Gimbal
CM:	_____._____	_____._____	_____._____
LM:	_____._____	_____._____	_____._____

7. MCC calculates gyro torquing angles and reports them to LM.

LM GTA's = _____._____ X, _____._____ Y, _____._____ Z

8. CDR disables jet firings and performs fine align (V42E), loading the gyro torquing angles voiced up from MCC.

LM GYRO DRIFT

Docked (Noun 20 Method)

The LM IMU drift check is performed by MCC using a set of simultaneous CM and LM ICDU angles.

Crew Report: GET _____:_____:_____ Δ T = _____._____ hrs.
(Time since previous Noun 20)

	Outer Gimbal	Inner Gimbal	Middle Gimbal
CM:	_____._____	_____._____	_____._____
LM:	_____._____	_____._____	_____._____

MCC calculates gyro torquing angles: ☐_____._____ X, ☐_____._____ Y, ☐_____._____ Z

.230° X, .520° Y, 1.90° Z,

The above limits are based on the following requirements:

1. Maximum platform misalignment at PDI = .19° about X_{sm} to assure that crossrange error at touchdown < 1 kilometer.

2. Maximum platform misalignment at PDI = .5° about Y_{sm} to assure a safe descent abort capability.

3. PGNCS is No/Go if drift rate > 100 meru about any axis.

Although the restrictive requirements concern the state of platform alignment at PDI, high drift rate can negate a perfect platform realignment (P52) performed 80 minutes before PDI.

The equivalent drift rates allowable are:

.145 deg/hr (X) .376 deg/hr (Y) 1.5 deg/hr (Z)

The GTA limits utilize these drift rates, assume 75 minutes between Noun 20 entries, and allow .05° for total measurement error.

Undocked (P52 Method)

The gyro torquing angles obtained during the IMU realignment program (P52) can be used to calculate the rate of platform drift since the last realignment.

Rev. 12 P52 GET = _____:_____:_____

Time of previous align = _____:_____:_____

Δ T (difference) = _____:_____ = _____._____ hours

Gyro Torquing Angles ☐_____._____°(X) ☐_____._____°(Y) ☐_____._____°(Z)

÷ (.015)Δ T (S) S = -1 S = -1 S = +1

= Drift Rate (meru): _____(X) _____(Y) _____(Z)

NOTE: As presently planned, the Rev. 12 GTA's will be torqued out to serve as a baseline for the Rev 13 P52. The time-of-previous-align used in the Rev 12 drift calculation will nominally be the GET of the P52 GTA's during Docked Fine Align. However, allowance must be made for any changes in the compensation values during this period. In spite of the GTA limits defined for Docked Gyro Drift (above), Mission Rules provide for uplinking new compensation values whenever the drift rate exceeds 5 meru on any axis.

Rev. 13 P52 GET = _____:_____:_____

Time of Previous Align = _____:_____:_____

Δ T (difference) = _____:_____ = _____._____ hours
(2.0)

Gyro Torquing Angles ☐_____._____°(X) ☐_____._____°(Y) ☐_____._____°(Z)
Limits .370° .830° 3.000°

GTA ÷ (.015) Δ T (S) S = -1 S = -1 S = +1

= Drift Rate (meru): _____(X) _____(Y) _____(Z)

NOTE: The Rev 13 GTA's will be torqued if they do not exceed the limits shown. These limits are based on the equivalent drift rates allowed during the Docked Gyro Drift measurement (above). They assume 2.0 hours between the two P52's, and allow .08° for AOT measurement errors. If the limits are exceeded PDI will be delayed 1 Rev.

P41 — RCS THRUSTING

Separation

V37 Enter, 41 Enter
V50 N18 Flashing, Request Maneuver to FDAI R, P, Y Angles
V06 N18, FDAI R, P, Y Angles After Maneuver to Burn Attitude
V06 N85, X, Y, Z Body Axes Velocity to be Gained
V16 N85 (Average G on at TIG -30) Velocity to be Gained
V16 N85 Flashing, Body Axes Residuals (to be Nulled)

						50-18	Roll										
							Pitch	(deg)									
							Yaw										
						06-18	Roll										
							Pitch	(deg)									
							Yaw										
						06-85	X										
							Y	VG (ft/s)									
							Z										
						16-85	X										
							Y	VG (ft/s)									
							Z										
						16-85	X										
							Y	Residuals (ft/s)									
							Z										
						X											
						Y	Trim (ft/s)										
						Z											

P47—THRUST MONITOR (LM)

Separation

V37 Enter, 47 Enter
V16 N83 Flashing, ΔV XYZ Body Axes
N62 Enter
V16 N62 Flashing, Inertial Velocity, Altitude Rate, Altitude

X	X	X				R				X	X	X			
X	X	X				P	IMU Gimbal Angles (degrees)			X	X	X			
X	X	X				Y				X	X	X			
X	X	X				BT	(min:s)			X	X	X			
						VI	(ft/s)								
						X		N83							
						Y	ΔV ft/s								
						Z									

NOTES:

P30–EXTERNAL ΔV CIRCULARIZATION

V37 Enter, 30 Enter

V06 N33 Flashing, Load Desired GETI

V06 N81 Flashing, Load Desired ΔV

						Purpose								
			/			Prop/Guidance				/				
+						Weight (lb) N47	+							
	0	0				P_{Trim} N48		0	0					
	0	0				Y_{Trim} (degrees)		0	0					
+	0	0				Hours N33	+	0	0					
+	0	0	0			Minutes GETI	+	0	0	0				
+	0					Seconds	+	0						
						ΔV_X N81								
						ΔV_Y LV								
						ΔV_Z (ft/s)								
X	X	X				R	X	X	X					
X	X	X				P IMU Gimbal Angles (deg)	X	X	X					
X	X	X				Y	X	X	X					
+						H_{Apogee} N44	+							
						$H_{Perigee}$ nmi								
+						ΔVT (ft/s)	+							
X	X	X				BT (min:s)	X	X	X					
X						ΔVC (ft/s)	X							
X	X	X	X			SXT Star	X	X	X	X				
+					0	SFT (degrees)	+					0		
+				0	0	TRN (degrees)	+				0	0		
X	X	X				BSS (Coas Star)	X	X	X					
X	X					SPA (Coas Pitch, deg)	X	X						
X	X	X				SXP (Coas X Pos, deg)	X	X	X					
	0					LAT N61		0						
						LONG (degrees)								
+						RTGO (nmi) EMS	+							
+						VIO (ft/s)	+							
						GET 0.05 g Hr:min:s								
						SET STARS								
X	X	X				R_{Align}	X	X	X					
X	X	X				P_{Align}	X	X	X					
X	X	X				Y_{Align}	X	X	X					
						ULLAGE								

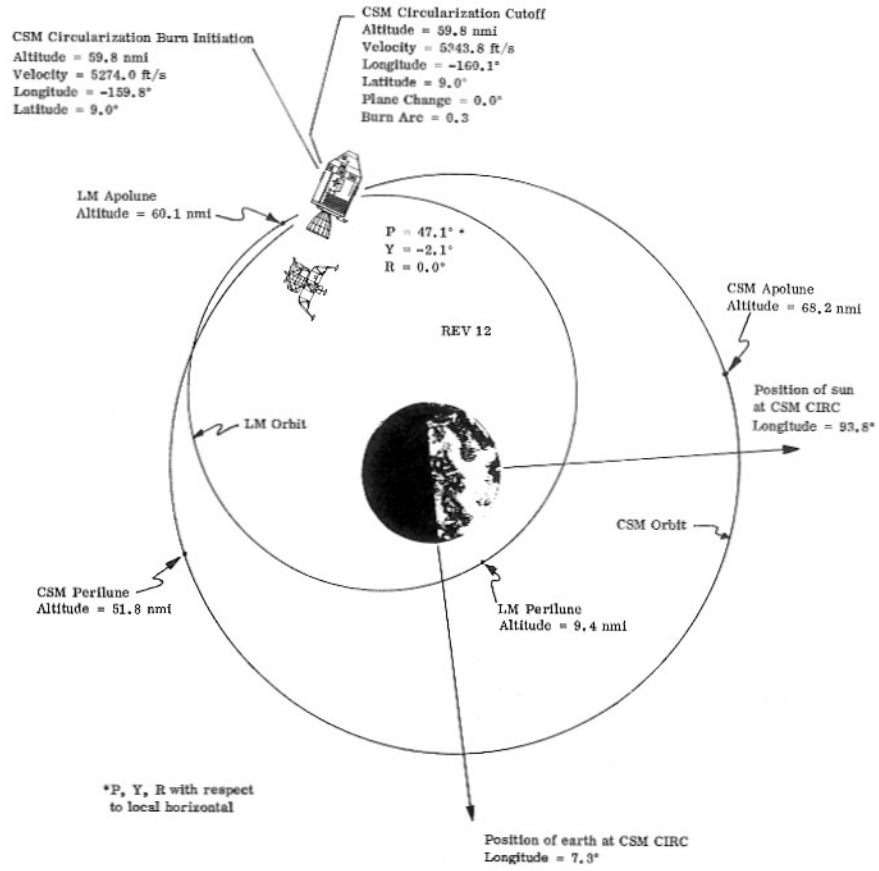
NOTES:

CSM LUNAR ORBIT CIRCULARIZATION

EVENT	BT/ΔV	G.E.T.	PROPULSION/ GUIDANCE	PRETHRUST TARGETING
CSM CIRCULARIZATION (POSIGRADE)	5.9/99.6	97:41:44.5	SPS/G&N EXT Δ V (P-40)	P-30

						ΔV_x N85	+	x	x				h	
						ΔV_y RESIDUALS (ft/s)	+	x	x	x			min	GET
						ΔV_z (BODY AXIS)	+	x					s	

$V_{x_{TRIM}}$ $V_{y_{TRIM}}$ $V_{z_{TRIM}}$ (ft/s)



NO PDI +12 ABORT PAD

+	0	0				Hours	N33	+	0	0			
+	0	0	0			Minutes GETI		+	0	0	0		
+	0					Seconds E		+	0				
						ΔV_X	N81						
						ΔV_Y LV (ft/s)							
						ΔV_Z F							
+						H_{Apogee}	N42	+					
						$H_{Perigee}$ (nmi)							
+						ΔV_R (ft/s)		+					
X	X	X				BT (min:s)		X	X	X			
X	X	X				R FDAI Inertial		X	X	X			
X	X	X				P Angles (degrees)		X	X	X			
+						Minutes TIG (AGS) 373		+					
						ΔV_X	N86						
						ΔV_Y AGS Targeting (ft/s)							
						ΔV_Z							
+	0	0				Hours	N11	+	0	0			
+	0	0	0			Minutes TIG of CSI		+	0	0			
+	0					Seconds G		+	0				
+	0	0				Hours	N37	+	0	0			
+	0	0	0			Minutes TIG of TPI		+	0	0	0		
+	0					Seconds H		+	0				

P63—BRAKING PHASE

V37 Enter, 63 Enter
V06 N61 Flashing
TG, TFI, crossrange (min/s, min/s, 0.1 nmi)
N33 Enter
V06 N33 Flashing
Time of Ignition (h, min, s)
V50 N18 Flashing
Roll, Pitch, Yaw FDAI Angles (0.01°)
V50 N25 Flashing
R1: 00500 (position LR to Position 1)
V50 N25 Flashing
R1: 00203 (switch Guidance Control to PGNS, Mode to Auto, Thrust Control to Auto)
V06 N62 Inertial velocity, time from ignition, ΔV (accumulated)
(0.1 ft/s, min/s, 0.1 ft/s)
V99 N62 Flashing
Engine on Enable Request
V06 N63 Flashing
Δ Altitude (+LR > LGC), HDOT, H (ft, 0.1 ft/s, ft)

+	0	0				Hours	N33	+	0	0			
+	0	0	0			Minutes TIG for PDI		+	0	0	0		
+	0					Seconds I		+	0				
X	X					min:s TGO	N61	X	X				
						nmi Crossrange							
X	X	X				Roll	N18	X	X	X			
X	X	X				Pitch FDAI inertial angles at PDI (deg)		X	X	X			
X	X	X				Yaw		X	X	X			
						231 Landing Site Radius (AGS) if ROD.							

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

PDI 0 ABORT PAD

+	0	0				Hours		N33	+	0	0			
+	0	0	0			Minutes	GETI		+	0	0	0		
+	0					Seconds		A	+	0				
						ΔV_X		N81						
						ΔV_Y	LV (ft/s)							
						ΔV_Z		B						
+						H_{Apogee}		N42	+					
						$H_{Perigee}$	(nmi)							
+						ΔV_R (ft/s)			+					
X	X	X				BT (min:s)			X	X	X			
X	X	X				R	FDAI Inertial		X	X	X			
X	X	X				P	Angles (degrees)		X	X	X			
+						Minutes	TIG (AGS)	373	+					
						ΔV_X		N86						
						ΔV_Y	AGS Targeting (ft/s)							
						ΔV_Z								
+	0	0				Hours		N11	+	0	0			
+	0	0	0			Minutes	TIG of CSI		+	0	0			
+	0					Seconds		C	+	0				
+	0	0				Hours		N37	+	0	0			
+	0	0	0			Minutes	TIG of		+	0	0	0		
+	0					Seconds	TPI	D	+	0				

(1 < PDI ⩽ 6) ABORT PAD

								Log Insertion GET (h:min:s)									
	+	1	0	0	0	0											
								Boost GET (h:min:s)									
	+	1	0	0	0	0											
								HAM, GET (h:min:s)									
	+	1	0	0	0	0											
								CSI, GET (h: min:s)									
+	0	0				Hours		N37	+	0	0			
+	0	0	0			Minutes	TIG of TPI		+	0	0	0		
+	0					Seconds		J	+	0				

T1 (6 < PDI ⩽ 15) ABORT PAD

								Log Insertion GET (h:min:s)									
		+	5	5	0	0											
								TIG of CSI (h:min:s)									
+	0	0				Hours		N37	+	0	0			
+	0	0	0			Minutes	TIG of TPI		+	0	0	0		
+	0					Seconds		K	+	0				

T2 (PDI + 21:26) ABORT PAD

								Log Insertion GET (h:min:s)									
		+	5	0	0	0											
								Boost GET (h:min:s)									
	+	1	0	0	0	0											
								HAM, GET (h:min:s)									
		+	5	0	0	0											
								CSI, GET (h:min:s)									
+	0	0				Hours		N33	+	0	0			
+	0	0	0			Minutes	TIG		+	0	0	0		
+	0					Seconds		L	+	0				
+	0	0				Hours		N37	+	0	0			
+	0	0	0			Minutes	TIG of TPI		+	0	0	0		
+	0					Seconds		M	+	0				

T3 (1 REV) ABORT PAD

								Log Insertion GET (h : min : s)									
		+	5	0	0	0											
								CSI TIG (h : min : s)									
	+	1	3	3	0	0											
								TPI TIG (h : min : s)									
+	0	0				Hours		N33	+	0	0			
+	0	0	0			Minutes	TIG		+	0	0	0		
+	0					Seconds		N	+	0				

P76 – STATE VECTOR UPDATE (CSM)

V37 Enter, 76 Enter

V06N33 Flashing, TIG

V06N84 Flashing, ΔV (LV) of CSM

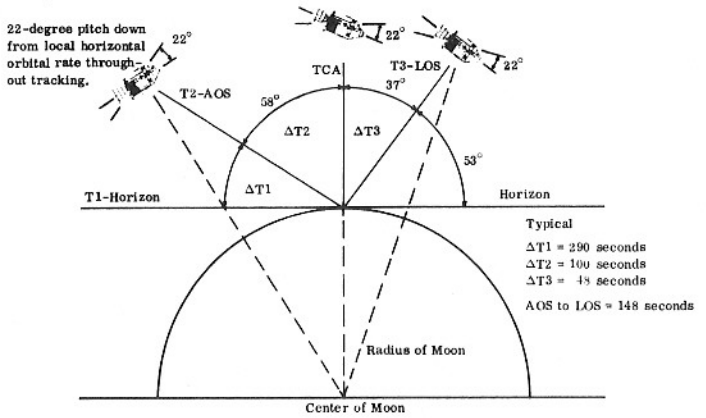
						PURPOSE							
+	0	0				Hours	N33	+	0	0			
+	0	0	0			Minutes TIG		+	0	0	0		
+	0					Seconds		+	0				
						ΔV_X	N84						
						ΔV_Y LV of CSM (ft/s)							
						ΔV_Z							

						PURPOSE							
+	0	0				Hours	N33	+	0	0			
+	0	0	0			Minutes TIG		+	0	0	0		
+	0					Seconds		+	0				
						ΔV_X	N84						
						ΔV_Y LV of CSM (ft/s)							
						ΔV_Z							

NOTES:

P24 — LANDMARK TRACKING

CSM Landmark Tracking Profile



TGT: ( )

T_1 _ _ _ : _ _ : _ _

T_2 _ _ _ : _ _ : _ _

TCA _ _ _ : _ _ : _ _

T_3 _ _ _ : _ _ : _ _

R _ _ _ ° P _ _ _ ° Y _ _ _ ° (T2 ACQ)

N or S nmi _ _ / SA _ _ TA _ _ (T2 ACQ)

N89 LAT _ _ . _ _

LONG/2 _ _ . _ _

ALT _ _ _ . _ _

TGT: ( )

T_1 _ _ _ : _ _ : _ _

T_2 _ _ _ : _ _ : _ _

TCA _ _ _ : _ _ : _ _

T_3 _ _ _ : _ _ : _ _

R _ _ _ ° P _ _ _ ° Y _ _ _ ° (T2 ACQ)

N or S nmi _ _ / SA _ _ TA _ _ (T2 ACQ)

N89 LAT _ _ . _ _

LONG/2 _ _ . _ _

ALT _ _ _ . _ _

P24 RATE-AIDED OPTICS TRACKING

CMC – on (req)
ISS – on and aligned
SCS – on
BMAG MODE (3) – RATE 2
G&N PWR OPTICS – on
OPT ZERO – ZERO (verify)
OPT MODE – CMC

V37E 24E

F 06 89 — LAT, LONG/2, ALT (0.001°, 0.001°, 0.01 nmi)
LOAD LMK COORDS
OPT ZERO – OFF
PRO

06 92 — AUTO OPT SHF/TRUN (0.01°, 0.001°)
- F 05 09 00404 (TRUN >90°)
- MNVR to acquire
- PRO
- or V34E, F 37

OPTICS MODE – MAN

F 51 — MARK REQUEST
MARK (as often as desired)
To terminate:
PRO

F 37 — XXE
OPT ZERO – ZERO

BASIC REFERENCE COORDINATES AND REFSMMAT

The Basic Reference Coordinate system (BRC) is an orthogonal inertial coordinate system whose origin is located either at the earth or moon center of mass (Figure 1). The orientation of this coordinate system is defined by the line of intersection of the mean earth equatorial plane and the mean ecliptic at the beginning of the Besselian year which starts January 1.2516251, 1972. The X axis ($\underline{u}_{XI}$) is defined by the intersection of the earth's equatorial plane and the ecliptic in the direction of the ascending node. The Z axis ($\underline{u}_{ZI}$) is along the mean earth north pole, and Y axis ($\underline{u}_{YI}$) completes the right-handed triad.

This coordinate system is shifted from earth-centered to moon-centered when estimated vehicle position from the moon falls below 64,373,760 meters. It is likewise shifted from the moon back to the earth when the spacecraft position exceeds 64,373,760 meters. All navigation stars, lunar-solar ephemerides and vehicle state vectors are referenced to this system (Figure 2).

REFSMMAT. The matrix used to transform the elements of a vector given in BRC space to IMU space is known as REFSMMAT.

Nine REFSMMAT's or IMU alignments are utilized during this mission. Each is a unique matrix which locates a stable member axis ($\underline{u}_{XSM}$, $\underline{u}_{YSM}$, or $\underline{u}_{ZSM}$) in BRC space (Figure 3).

IMU REALIGNMENT. Any desired IMU orientation with respect to the BRC system and its associated REFSMMAT can be obtained from star sightings (Program P52).

The procedure generally used to change the alignment of the IMU from one of the five primary attitudes to another is as follows:

- The astronaut executes Program P52, Option 3. This realigns the IMU to the present inertial attitude thereby eliminating the effects of gyro drift.
- The astronaut executes Program P52, Option 1. The REFSMMAT for Option 1 is generally uplinked prior to entering P52. When executed, the program computes and displays the IMU gimbal angles for the desired IMU attitude using the present vehicle attitude.

A total of four options are available to the crew when executing P52 (Figure 4). The basic difference between options is the manner in which REFSMMAT is obtained. The basic orthogonalization procedure used to compute REFSMMAT is shown in Figure 5.