WATSON

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-208

December 21, 1970

APOLLO 14 (MISSION H-3)
FINAL CREW CHARTS

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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PROJECT APOLLO

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By Larry D. Davis, Data Management Group
Mission Planning Support Office

December 21, 1970

MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Approved: John R. Gurley Jr. for
Richard P. Parten, Chief
Mission Planning Support Office

Approved: J. P. Mayer
John P. Mayer, Chief
Mission Planning and Analysis Division

FOREWORD

The purpose of this document is to present the Mission Planning and Analysis Division (MPAD) final crew charts for the Apollo 14 (H-3) mission onboard data file. The command and service module (CSM) charts are in part I, and the lunar module (LM) charts are in part II. These charts were generated by MPAD in response to a request from the Flight Crew Support Division (FCSD)[a] and were coordinated by the Data Management Group of the Mission Planning Support Office with Ted Guillory of the Flight Planning Branch of FCSD.

The crew charts presented in this document reflect the Apollo 14 trajectory, consumables, and flight plan status as of December 11, 1970. Any changes to these final crew charts that occur before lift-off will be forwarded to FCSD for incorporation into the onboard data file. Finally, the dependence of each crew chart (i.e., mission independent, profile dependent, flight plan dependent, etc.) is noted on each chart.

Any questions concerning the enclosed crew charts should be directed to Larry D. Davis, Mission Planning Support Office, HU3-4091.

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[a]Memo CF63-70M-194, dated June 25, 1970, signed by T. W. Holloway.

CREW CHARTS

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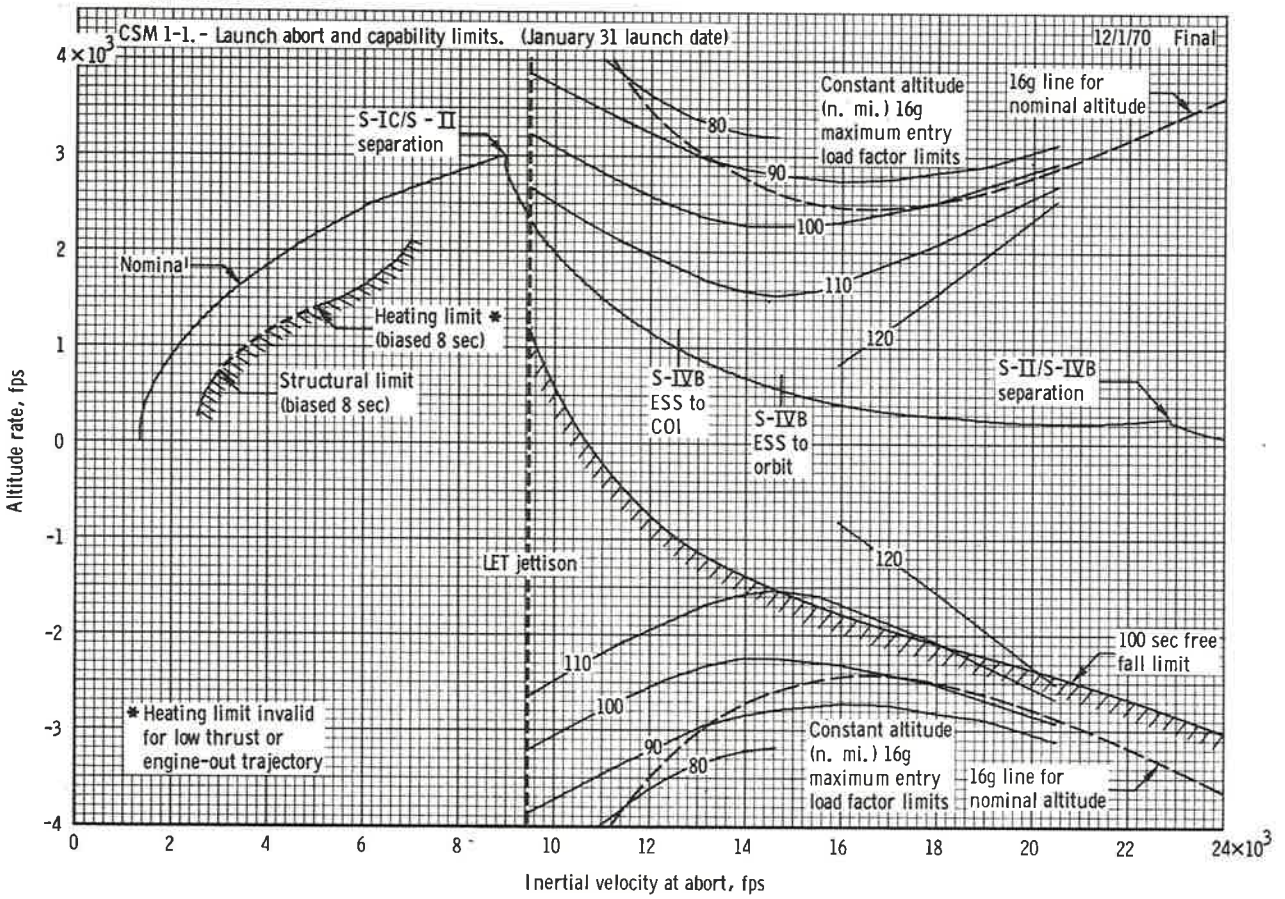
Henderson/FAB/MPAD (for Launch Checklist)
Data source SODB Vol. III Amend. 88, MSFC Apollo 14 launch traj. (Ψ = 72.067)
Tape #15655 Rec'd 10/13/70
Data confirmed

Mission profile dependent



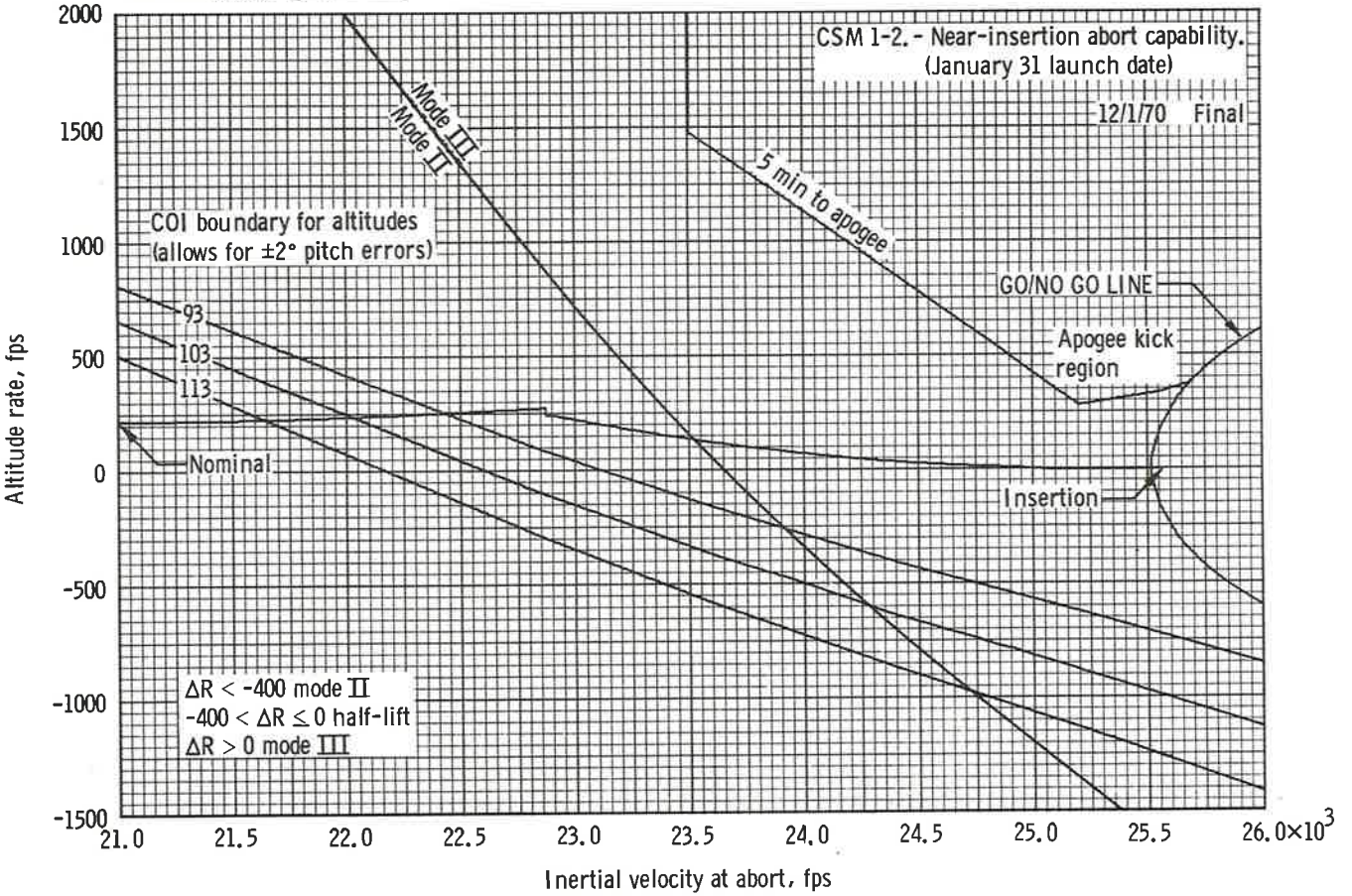
Launch abort and capability limits.

Henderson/FAB/MPAD (for Launch Checklist)

Data source SODB Vol. III Amend. 88, MSFC Apollo 14 launch traj. (ψ = 72.067)
Tape #15655 Rec'd 10/13/70

Data confirmed

Mission profile dependent



Near-insertion abort capability.

Henderson/FAB/MPAD (for Launch Checklist, CSM Cue Cards)
Data source MSFC Apollo 14 launch traj. (Ψ =72.067°)
Data confirmed [signature] Tape #15655 Rec'd 10/13/70

Mission profile dependent

CSM 1-3.- Launch trajectory parameters - Saturn V boost. (January 31 launch date)
12/8/70 Final Revision 1

SATURN V BOOST

	DET	θ	V_I	$\dot{H}$	H
	00:00	90	1341	0	-.0
	:30	85	1394	271	.6
	1	69	1829	755	3.0
	1:30	51	2920	1405	8.3
	2	34	4853	2113	17.0
a	2:15	29	6202	2489	22.7
	2:30	25	7442	2720	29.1
b	2:45	22	8938	2988	36.0
	3	22	9103	2688	43.1
	3:30	24	9657	2195	55.1
	4	26	10291	1836	65.1
	4:30	24	11018	1508	73.3
	5	21	11846	1211	80.0
	5:30	17	12778	947	85.3
	6	14	13823	719	89.4
	6:30	11	14998	531	92.5
	7	7	16320	388	94.7
	7:30	4	17817	298	96.4
	8	3	19289	244	97.7
	8:30	-1	20572	214	98.8
	9	-5	21999	232	99.9
c	9:17	-7	22862	272	100.6
	9:30	-9	22999	217	101.1
	10	-13	23527	128	102.0
	10:30	-17	24083	58	102.4
	11	-20	24668	13	102.6
	11:30	-23	25281	-9	102.6
d	11:43	-23	25562	-1	102.6

[a]Timebase 2 (S-IC center-engine + .01 sec)
[b]Timebase 3 (S-IC outboard-engine cutoff + .01 sec)
[c]Timebase 4 (S-II engine cutoff + .01 sec)
[d]Timebase 5 (S-IVB guidance cutoff signal + .21 sec)

Henderson/FAB/MRAD (for Launch Checklist) Mission independent
Data source Apollo 13
Data confirmed

CSM 1-4.- Recommended manual EOI shutdown velocities. 12/1/70 Final

SHUTDOWN ALTITUDE, h (N. MI.)	INERTIAL VELOCITY, Vi (fps)	ha/hp (N. MI.)
150	25309	150/100
145	25336	145/100
140	25362	140/100
135	25389	135/100
130	25416	130/100
125	25442	125/100
120	25469	120/100
115	25496	115/100
110	25523	110/100
105	25550	105/100
100	25577	100/100
95	25604	100/95
90	25631	100/90
85	25659	100/85
80	25686	100/80
75	25713	100/75

NOTE: $\dot{h}$ = 0 AT SHUTDOWN

Fraley/FAB/MPAD (for Launch Checklist)
Data source Update to MSC Int. Note 70-FM-45
Data confirmed C. W. F.

Launch day dependent
Launch month dependent
Mission profile dependent

CSM 2-1.- Gimbal angles for observing S-IVB through CSM hatch window after CSM/LM ejection. (January 31 launch date)

12/1/70 Final

Time from ejection min:sec		S-IVB APS EVASIVE MANEUVER			SM RCS BACKUP EVASIVE MANEUVER		
		SC inertial attitude, deg			SC inertial attitude, deg		
		Roll	Pitch	Yaw	Roll	Pitch	Yaw
CSM/LM ejection	00:00						
S-IVB acquired in hatch window	13:00	90.0	339.6	355.8	90.0	339.6	355.8
	23:00	90.0	339.6	355.8	90.0	339.6	355.8
	25:00	90.0	339.6	21.5	73.7	323.9	0.0
	30:00	90.0	159.7	26.1	90.0	339.5	2.2
	35:00	90.0	159.7	15.8	90.0	339.5	5.7
	40:00	90.0	159.7	11.6	90.0	339.5	8.7
S-IVB venting maneuver	44:20	90.0	160.7	8.9	90.0	333.4	12.8
	50:00	47.4	147.7	0.0	5.0	166.5	0.0
	55:00	31.6	146.8	0.0	355.2	163.0	0.0

Based on launch site refsmmat

Gonzales/Scheffman/LMAB/MPAD
Data source MSFC B7 TAPE
Data confirmed DSC d.d.

Launch day dependent
Launch month dependent

CSM 3-1 12/1/70 Final

S-IVB TLI - NOMINAL
FIRST OPPORTUNITY
(JANUARY 31 LAUNCH DATE)

DET	θ	ψ	V_I	$\dot{H}$	H
0:00	127	0.6	25579	19	106
:30	120	0.2	26154	9	106
1	119	0.7	26766	27	106
1:30	118	1.0	27406	103	106
2	117	1.2	28076	244	107
2:30	117	1.4	28817	458	109
3	116	1.0	29641	757	112
3:30	115	1.5	30510	1150	117
4	113	2.0	31429	1639	123
4:30	112	2.4	32405	2233	133
5	110	2.9	33446	2934	146
5:30	104	3.4	34566	3734	162
5:56	105	3.4	35517	4495	180

Gonzales/Scheffman/LMAB/MPAD
Data source MSFC B7 TAPE
Data confirmed RSS

Launch day dependent
Launch month dependent

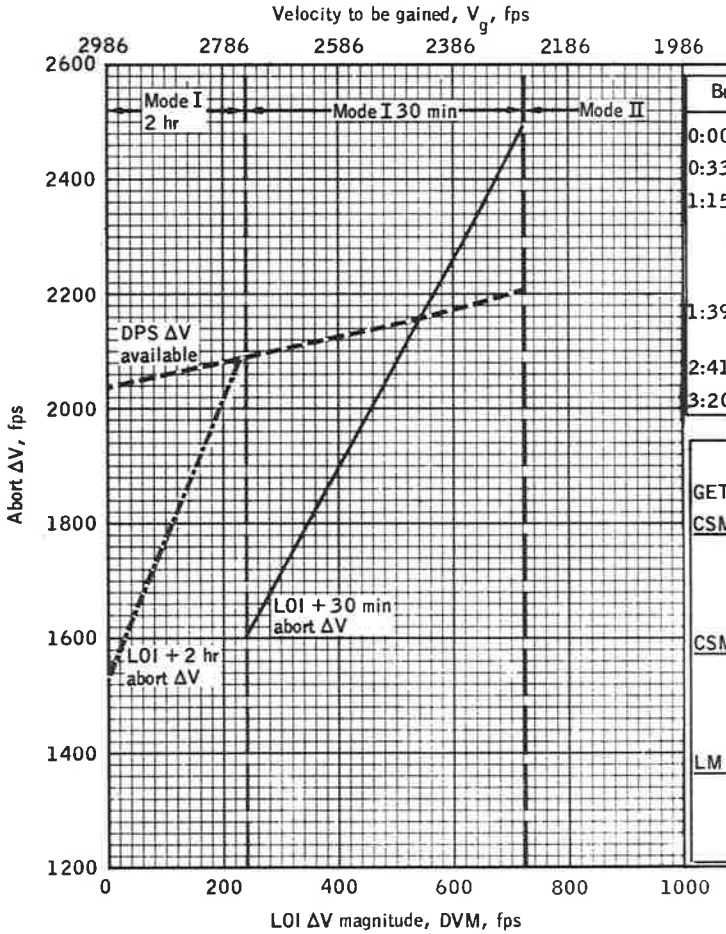
CSM 3-2 12/1/70 Final

S-IVB TLI - NOMINAL
SECOND OPPORTUNITY
(JANUARY 31 LAUNCH DATE)

DET	θ	ψ	V_I	$\dot{H}$	H
0:00	127	358.8	25573	20	108
:30	120	0.7	26214	17	108
1:	119	0.8	26905	51	108
1:30	118	0.7	27633	148	108
2	117	0.5	28399	316	110
2:30	116	0.4	29206	563	112
3	115	0.2	30055	898	115
3:30	113	0.1	30953	1329	121
4	112	359.9	31905	1864	129
4:30	110	359.8	32920	2508	139
5	108	359.6	34007	3265	154
5:30	105	359.5	35182	4112	172
5:40	105	359.5	35526	4419	179

Gonzales/LMAB/MPAD (for G and C Checklist)
Data source Apollo 14 oT
Data confirmed L.L.

TLI trajectory, launch date



LOI mode I DPS abort.

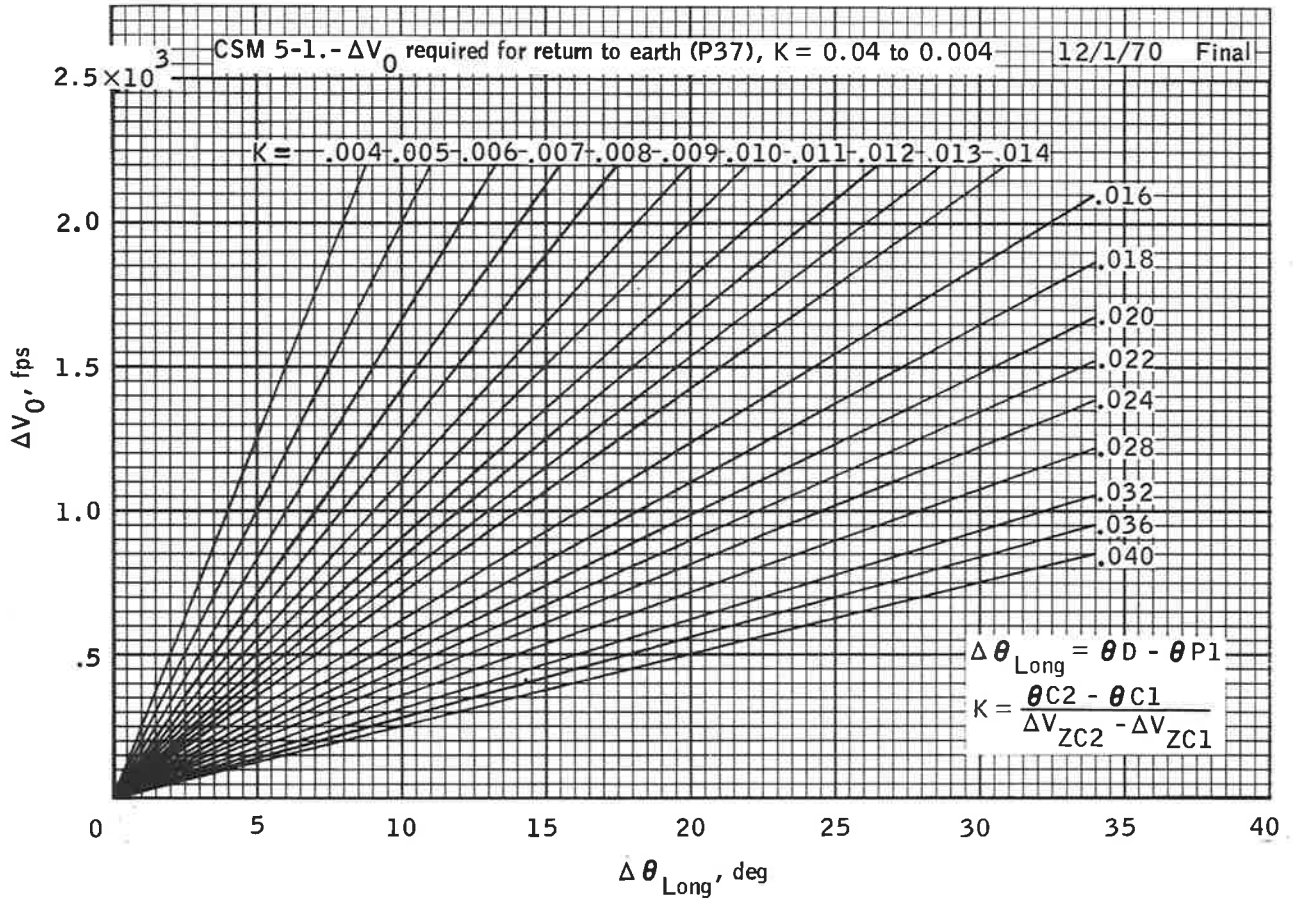
CSM 4-1.- LOI mode I DPS abort. 11/13/70 Final

Burntime	ΔVM	Mode	SPS	Type
0:00 - 0:33	0 - 238	I	TIGHT	DPS at 2 hr (RTCC)
0:33 - 1:15	238 - 545	I	LOOSE	DPS at 30 min (crewchart)
1:15 - 1:39	545 - 725	I	LOOSE	DPS at 30 min to depletion + APS at 2 1/2 hr (RTCC); Loss of comm, DPS followed immediately by APS (crewchart)
1:39 - 2:41	725 - 1202	II	LOOSE	DPS at 2 hr + DPS at perilune (RTCC)
2:41 - 3:20	1202 - 1513	III	LOOSE	DPS at perilune (RTCC)
3:20 - Cutoff	1513 - Cutoff	III	TIGHT	DPS at perilune (RTCC)

	Nominal	Update
GET LOI ignition	82:38:13.63	
CSM IMU angles for LOI + 30 min DPS abort		
GET abort ignition	83:08:13.63	
Roll	127	
Pitch	263	
Yaw	348	
CSM IMU angles for LOI + 2 hr DPS abort		
GET abort ignition	84:38:13.63	
Roll	301	
Pitch	261	
Yaw	350	
LM FDAI angles for LOI + 2 hr DPS abort		
GET abort ignition	84:38:13.63	
Roll	10	
Pitch	81	
Yaw	1	

Gonzales/LMAB/MPAD (for G and C Checklist)
Data source MIT-AG #239-69, Apollo Doc. Group Memo #5
Data confirmed S. G.

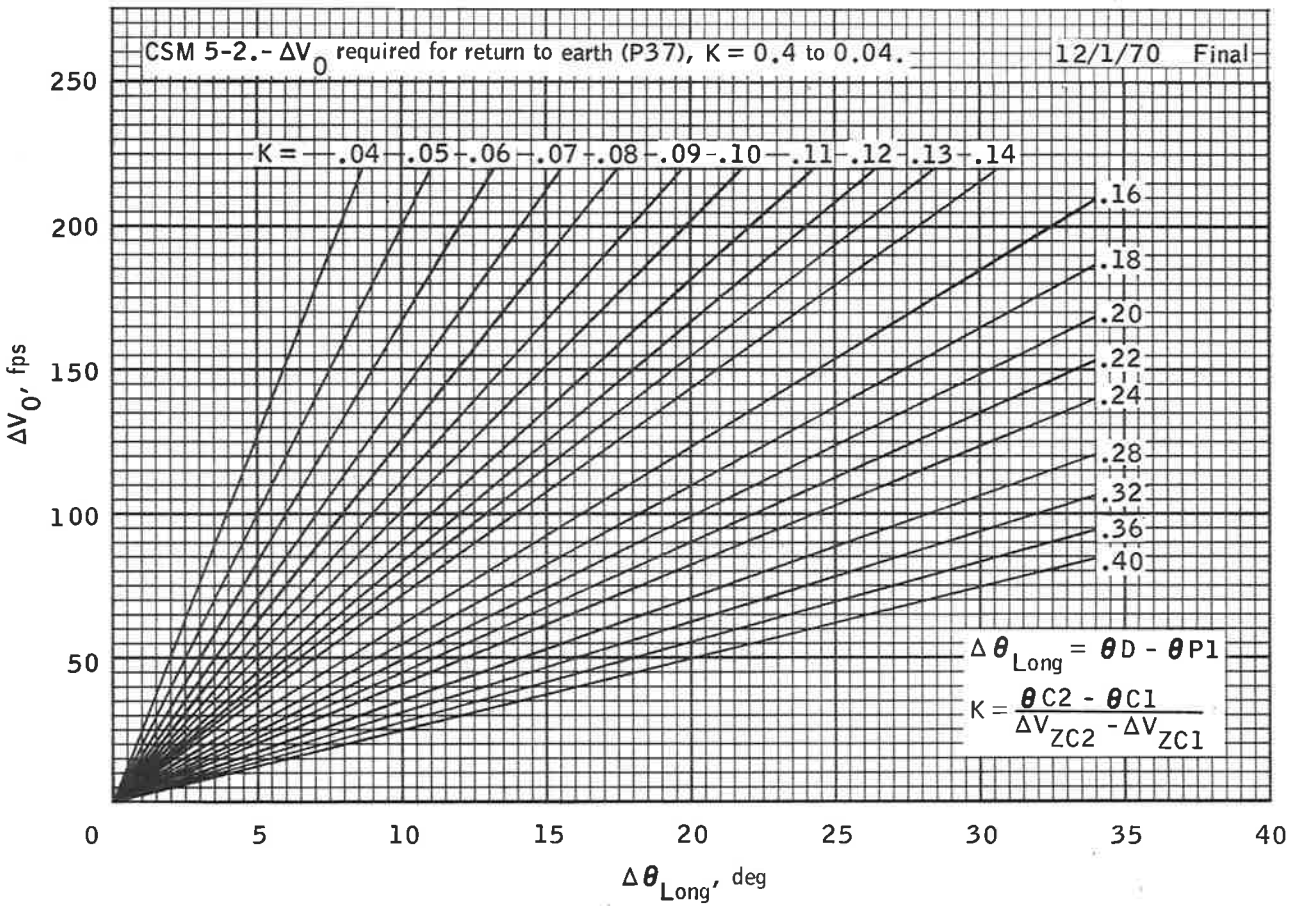
Mission independent



ΔV_0 required for return to earth (P37), K = 0.04 to 0.004.

Gonzales/LMAB/MPAD (for G and C Checklist)
Data source MIT - AG #239-69, Apollo Doc. Group Memo #5
Data confirmed L. G.

Mission independent



ΔV_0 required for return to earth (P37), K = 0.4 to 0.04.

Blucker/MPB/MPAD (for G and C Checklist)
Data source JPL Ephem tape 68
Data confirmed 9/4/70

Launch day dependent
Launch month dependent

CSM 6-1.- Venus unit vectors.

12/1/70 Final

0 HR GET = 1:31:20:20 GMT
LO = 1:31:__:__

TIME (GET) HOURS	VENUS UNIT VECTOR (LAUNCH JAN 31,1971 20.0HR GMT) X(R1)	Y(R2)	Z(R3)
.0	-.08900	-.93419	-.34550
4.0	-.08591	-.93439	-.34575
8.0	-.08282	-.93457	-.34600
12.0	-.07973	-.93475	-.34624
16.0	-.07664	-.93492	-.34648
20.0	-.07355	-.93508	-.34672
24.0	-.07046	-.93523	-.34695
28.0	-.06737	-.93537	-.34718
32.0	-.06428	-.93551	-.34741
36.0	-.06118	-.93563	-.34764
40.0	-.05809	-.93574	-.34786
44.0	-.05499	-.93585	-.34808
48.0	-.05189	-.93595	-.34830
52.0	-.04879	-.93603	-.34851
56.0	-.04569	-.93611	-.34872
60.0	-.04259	-.93618	-.34893
64.0	-.03948	-.93624	-.34914
68.0	-.03638	-.93629	-.34934

TIME (GET) HOURS	VENUS UNIT VECTOR (LAUNCH JAN 31,1971 20.0HR GMT) X(R1)	Y(R2)	Z(R3)
72.0	-.03327	-.93633	-.34954
76.0	-.03016	-.93636	-.34974
80.0	-.02705	-.93639	-.34993
84.0	-.02394	-.93640	-.35012
88.0	-.02083	-.93640	-.35031
92.0	-.01771	-.93640	-.35049
96.0	-.01459	-.93638	-.35067
100.0	-.01148	-.93636	-.35085
104.0	-.00836	-.93633	-.35103
108.0	-.00524	-.93629	-.35120
112.0	-.00211	-.93623	-.35137
116.0	.00101	-.93617	-.35153
120.0	.00414	-.93610	-.35170
124.0	.00727	-.93603	-.35186
128.0	.01040	-.93594	-.35201
132.0	.01353	-.93584	-.35217
136.0	.01667	-.93573	-.35232
140.0	.01980	-.93562	-.35246

CSM 6-1.- Concluded.

12/1/70 Final

0 HR GET = 1:31:20:20 GMT
LO = 1:31:__:__

TIME (GET) HOURS	VENUS (LAUNCH JAN 31,1971 20.0HR GMT) UNIT VECTOR X(R1)	Y(R2)	Z(R3)
144.0	.02294	-.93549	-.35261
148.0	.02608	-.93536	-.35275
152.0	.02922	-.93521	-.35288
156.0	.03237	-.93506	-.35302
160.0	.03551	-.93489	-.35315
164.0	.03866	-.93472	-.35327
168.0	.04181	-.93454	-.35340
172.0	.04496	-.93435	-.35352
176.0	.04812	-.93415	-.35363
180.0	.05128	-.93393	-.35375
184.0	.05443	-.93371	-.35386
188.0	.05759	-.93348	-.35396
192.0	.06076	-.93325	-.35406
196.0	.06392	-.93300	-.35416
200.0	.06709	-.93274	-.35426
204.0	.07026	-.93247	-.35435
208.0	.07343	-.93219	-.35444
212.0	.07660	-.93190	-.35452

TIME (GET) HOURS	VENUS (LAUNCH JAN 31,1971 20.0HR GMT) UNIT VECTOR X(R1)	Y(R2)	Z(R3)
216.0	.07978	-.93161	-.35460
220.0	.08295	-.93130	-.35468
224.0	.08613	-.93098	-.35475
228.0	.08932	-.93066	-.35482
232.0	.09250	-.93032	-.35489
236.0	.09568	-.92998	-.35495
240.0	.09887	-.92962	-.35501
244.0	.10206	-.92925	-.35506

Blucker/MPB/MPAD (for G and C Checklist)
Data source JPL Ephemeris Tape
Data confirmed 9/4/70

Launch day dependent
Launch month dependent

CSM 6-2.- Mars, Jupiter, Saturn unit vectors.

12/1/70 Final

0 HR GET = 1:31:20:20 GMT
LO = 1:31:__:__

TIME (GET) HOURS	MARS UNIT VECTOR (LAUNCH JAN 31,1971 20.0HR GMT) X(R1)	Y(R2)	Z(R3)
.0	-.41404	-.83881	-.35351
10.0	-.40993	-.84048	-.35432
20.0	-.40582	-.84214	-.35512
30.0	-.40170	-.84378	-.35592
40.0	-.39758	-.84540	-.35671
50.0	-.39345	-.84699	-.35749
60.0	-.38932	-.84857	-.35826
70.0	-.38518	-.85014	-.35903
80.0	-.38104	-.85168	-.35979
90.0	-.37689	-.85320	-.36055
100.0	-.37274	-.85471	-.36129
110.0	-.36858	-.85620	-.36203
120.0	-.36441	-.85767	-.36277
130.0	-.36023	-.85913	-.36350
140.0	-.35605	-.86057	-.36422
150.0	-.35186	-.86199	-.36494
160.0	-.34765	-.86339	-.36565
170.0	-.34344	-.86477	-.36635

TIME (GET) HOURS	MARS UNIT VECTOR (LAUNCH JAN 31,1971 20.0HR GMT) X(R1)	Y(R2)	Z(R3)
180.0	-.33922	-.86614	-.36705
190.0	-.33499	-.86750	-.36774
200.0	-.33075	-.86883	-.36842
210.0	-.32650	-.87015	-.36910
220.0	-.32224	-.87145	-.36977
230.0	-.31797	-.87274	-.37044
240.0	-.31369	-.87401	-.37109
250.0	-.30940	-.87526	-.37175

TIME (GET) HOURS	JUPITER UNIT VECTOR (LAUNCH JAN 31,1971 20.0HR GMT) X(R1)	Y(R2)	Z(R3)
.0	-.45824	-.82167	-.33894
50.0	-.45392	-.82372	-.33978
100.0	-.44974	-.82568	-.34057
150.0	-.44570	-.82755	-.34134
200.0	-.44178	-.82935	-.34207
250.0	-.43797	-.83107	-.34278

TIME (GET) HOURS	SATURN UNIT VECTOR (LAUNCH JAN 31,1971 20.0HR GMT) X(R1)	Y(R2)	Z(R3)
.0	.69562	.67354	.24992
100.0	.69393	.67492	.25091
200.0	.69188	.67660	.25201

Pixley/MPB/MPAD (for G and C Checklist) Mission independent
Data source PAP
Data confirmed PAP

CSM 7-1.- Loss of comm navigation procedures. 12/1/70 Final Revision 1

LOSS OF COMM NAVIGATION

GENERAL RULES

1 A sighting or set is to consist of three marks.

2 Calibrate optics at the beginning of each batch and every half hour while navigation sightings in progress if the remaining sightings require more than 30 minutes to complete. The sextant calibration will be repeated until agreement of at least two checks (not necessarily sequential ones) are within 1 bit (.003°).

3 All attitude control should be done using coupled RCS thruster pairs.

4 While in P23 V06N49 display:
If ΔR >50 nm, Or ΔV >50 fps;
Reject mark, reselect star and repeat mark.

If large correction re-occurs, accept.

Corrections of above magnitude should not be expected except at initiation of tracking (first mark on each star in first batch) or at first switch of reference bodies.

Large ΔR, ΔV values may be expected at the following times:

At initiation of tracking (first mark of each star of first batch).

At first switch of reference bodies.

After long periods between sightings.

Last hours before EI.

5 Loss of W-Matrix after initiation of navigation sightings:

(a) Upon loss of W-Matrix, current onboard state vector is retained.

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Revision 1

(b) W-Matrix Reinitialization and Navigation Procedures

(1) Sightings Not In Progress:

Before next batch, reinitialize W-Matrix, V67 V06N99 Load values shown in tables.

Continue Navigation

(2) Sightings In Progress:

Immediately reinitialize W-Matrix, V67 V06N99 Load values shown in tables.

Restart interrupted batch of navigation sightings.

Continue navigation

GENERAL LOSS OF COMM NAV PROCEDURE

1 IF ENTRY PAD PREVIOUSLY RECEIVED, NO TRACKING PERFORMED.

IF NOT, PROCEED.

2 EXECUTE ABORT - IF REQUIRED (UNLESS COMM LOSS DURING NOMINAL TEC).

3 REINITIALIZE W-MATRIX, V67 (DIAGONAL VALUES, V06N99, FROM TABLES)

4 DETERMINE RETURN-TIME

5 SELECT NAVIGATION SCHEDULE (SEE TABLES). IF TABLE I, II, OR III ARE NOT APPLICABLE, REFER TO DO-IT-YOURSELF RULES.

6 SELECT STARTING BATCH
FIRST NAVIGATION SIGHTINGS TO USE STARS CORRESPONDING TO NAVIGATION SCHEDULE TIME FIRST OCCURRING AFTER ABORT.

7 ALTERNATE SIGHTINGS ARE PROVIDED IN THE EVENT THE PREFERRED SIGHTING CANNOT BE PERFORMED.

DO-IT-YOURSELF RULES

1 Reinitialize W-Matrix and schedule a tracking interval as soon as possible after the abort burn; or in the case of the lunar flyby, about 1 hour after perilune. If sightings are performed translunar for any reason, reinitialize the W-Matrix 1 hour after perilune for trans-earth sightings. W-Matrix values are given in tables IV-1 and 2 for each return type.

2 A batch is to consist of at least three star/horizon sightings, although as many as five can be advantageous, particularly following a sleep period.

3 All available stars should be used in the sighting schedule. No more than three marks should be taken on a star within a batch of data.

4 Sightings during the last 10 hours before entry interface are important. Five earth horizon sightings should be scheduled at EI-5 hours and three earth horizon sightings should be scheduled following the MCC at EI-3 hours. If no earth horizon sightings are available, lunar horizon sightings should be used.

5 Whenever possible, the navigation batches should be scheduled so that, immediately following a time period of length Δt (not to exceed 3 hours) in a non-PTC mode, five times Δt should be spent in a PTC mode (thermal constraints). This rule will be violated most frequently in the following situations: (1) aborts from a translunar trajectory with short return lengths, (2) time critical aborts, (3) the 10-hour period before entry interface.

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6 If possible, both near and far horizons should be included in each batch of data.

7 Star availability is related to GMT not GET. Therefore, as a clue to determine stars available, refer to either Table I, II, or III which has a GMT for entry corresponding to your GMT for entry. In addition, the star charts should be used to select available stars.

8 Go to Table IV.

Pixley/MPB/MPAD (for G and C Checklist)
Data source
Data confirmed

Launch day dependent
Launch month dependent
Mission profile dependent
January 31 launch date
12/1/70 Final

CSM 7-2.- Star sighting schedule for lift-off + 8 hr abort.

TABLE I.- LIFT-OFF + 8 HR ABORT

W-MATRIX REINITIALIZATION

R1 + 80000
R2 + 00070
R3 + 00003

NAVIGATION SCHEDULE

ΔT to EI < 20 hrs, TABLE I(a)
ΔT to EI > 20 hrs, TABLE I(b)

TABLE I(a)

Sighting Schedule for an Abort from Translunar Coast at 8:00 Hours, Short (Less than 20 hours) Return
(GMT of EI = February 1, 17 hours, 0 minutes)

Time	Star	Horizon	R3
EI - 13	24 Gienah	EF	00120
	33 Antares	EN	00110
	161	EF	00120
	*201	EN	00110
	*204	EN	00110
EI - 11	24 Gienah	EF	00120
	33 Antares	EN	00110
	30 Menkent	EF	00120
	*161	EF	00120
	*201	EN	00110
EI - 9	33 Antares	EN	00110
	161	EF	00120
	201	EN	00110
	*204	EN	00110
	* 30 Menkent	EF	00120
EI - 7	161	EF	00120
	204	EN	00110
	125	EN	00110
	*235	EN	00110
	* 30 Menkent	EF	00120
EI - 5	204	EN	00110
	235	EN	00110
	30 Menkent	EF	00120
	37 Nunki	EN	00110
	212	EN	00110

* Alternate Stars

TABLE I(a)

Sighting Schedule for an Abort from Translunar Coast at 8;00 Hours, Short (Less than 20 hours) Return (GMT of EI = February 1, 17 hours, 0 minutes) (Concluded)

EI - 2.5	124	EF	00120
	37 Nunki	EN	00110
	176	EF	00120
	*214	EN	00110
	*202	EF	00120

TABLE I(b)

Sighting Schedule for an Abort from Translunar Coast at 8:00 Hours, Long (Greater than 20 hours) Return (GMT of EI = February 2, 16 hours 50 minutes)

Time	Star	Horizon	R3
EI - 38	24 Gienah	EF	00120
	33 Antares	EN	00110
	154	EF	00120
	*175	EN	00110
	*201	EN	00110
EI - 35	24 Gienah	EF	00120
	33 Antares	EN	00110
	154	EF	00120
	175	EN	00110
	201	EN	00110
EI - 27	33 Antares	EN	00110
	154	EF	00120
	201	EN	00110
	161	EF	00120
	235	EN	00110
EI - 24	33 Antares	EN	00110
	201	EN	00110
	161	EF	00120
	*235	EN	00110
	* 30 Menkent	EF	00120
EI - 21	161	EF	00120
	235	EN	00110
	30 Menkent	EF	00120
	*204	EN	00110
	* 37 Nunki	EN	00110

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TABLE I(b)

Sighting Schedule for an Abort from Translunar Coast at 8:00 Hours, Long (Greater than 20 hours) Return (GMT of EI = February 2, 16 hours 50 minutes)
(Concluded)

Time	Star	Horizon	R3
EI - 12	235	EN	00110
	37 Nunki	EN	00110
	30 Menkent	EF	00120
	175	EF	00120
	33 Antares	EF	00120
EI - 9.5	33 Antares	EF	00120
	37 Nunki	EN	00110
	40 Altair	EN	00110
	*175	EF	00120
	*201	EF	00120
EI - 7	33 Antares	EF	00120
	201	EF	00120
	40 Altair	EN	00110
	* 37 Nunki	EN	00110
	*175	EF	00120
EI - 5	33 Antares	EF	00120
	201	EF	00120
	40 Altair	EN	00110
	175	EF	00120
	235	EN	00110
EI - 2.5	33 Antares	EF	00120
	204	EF	00120
	202	EF	00120

* Alternate Stars

Pixley/MPB/MPAD (for G and C Checklist)
Data source P.P
Data confirmed P.P

Launch day dependent
Launch month dependent
Mission profile dependent
January 31 launch date

CSM 7-3.- Star sighting schedule for aborts from lunar orbit. 12/1/70 Final

TABLE II.- ABORTS FROM LUNAR ORBIT

A. ABORTS BECAUSE OF LOSS OF COMM

W-MATRIX REINITIALIZATION
R1 +30000
R2 +00300
R3 +00003

NAVIGATION SCHEDULE
GMT RETURN ON FEBRUARY 9, TABLE II(a)
GMT RETURN ON FEBRUARY 10, TABLE II(b)

B. COMM LOSS AFTER ABORT FROM LUNAR ORBIT

W-MATRIX REINITIALIZATION

a. COMM LOSS PRIOR TO TIME FOR NAV STG BATCH 1
R1 + 30000
R2 + 00300
R3 + 00003

b. COMM LOSS AFTER TIME FOR BATCH 1 AND NO SV UPDATE AFTER TEI
R1 + 99000
R2 + 00020
R3 + 00003

c. COMM LOSS AFTER TIME FOR BATCH 1 AND AT LEAST ONE SV UPDATE AFTER TEI
R1 + 45000
R2 + 00006
R3 + 00003

NAVIGATION SCHEDULE
GMT EI FEBRUARY 9, TABLE II(a)
GMT EI FEBRUARY 10, TABLE II(b)
GMT NOT COVERED BY ABOVE, GO TO "DO-IT-YOURSELF", TABLE IV.

TABLE II(a)

January 31, 1971 Launch Date
Sighting Schedule for Abort from Lunar Orbit
(GMT of EI = 9 February 1971, 21 Hours)

Time	Star	Horizon	R3
TEI + 1.5	31 Arcturus	MN	00210
	24 Gienah	MN	00210
	151	MF	00220
	154	MN	00210
	26 Spica	MN	00210
TEI + 13	212	EF	00120
	33 Antares	EF	00120
	120	EN	00110
	*125	EF	00120
	*127	EF	00120
TEI + 16	50	MF	00220
	24 Gienah	MN	00210
	23 Denebola	MN	00210
	* 67	MF	00220
	* 16 Procyon	MF	00220
TEI + 20	212	EF	00120
	33 Antares	EF	00120
	120	EN	00110
	*125	EF	00120
	* 76	EF	00120
TEI + 24	212	EF	00120
	33 Antares	EF	00120
	120	EN	00110
	*125	EF	00120
	* 76	EF	00120
EI - 28	212	EF	00120
	33 Antares	EF	00120
	125	EF	00120
	* 76	EF	00120
	*127	EF	00120

TABLE II(a)

January 31, 1971 Launch Date
Sighting Schedule for Abort from Lunar Orbit
(GMT of EI = 9 February 1971, 21 Hours)
(Concluded)

Time	Star	Horizon	R3
EI - 23	212	EF	00120
	33 Antares	EF	00120
	125	EF	00120
	* 76	EF	00120
	*127	EF	00120
EI - 20	212	EF	00120
	33 Antares	EF	00120
	37 Nunki	EF	00120
	*125	EF	00120
	* 77	EF	00120
EI - 10	44 Enif	EN	00110
	37 Nunki	EF	00120
	212	EF	00120
	* 45 Formalhaut	EN	00110
	*213	EF	00120
EI - 5	23 Denebola	MF	00220
	22 Regulus	MF	00220
	64	MN	00210
	16 Procyon	MN	00210
	151	MF	00220
EI - 2.5	23 Denebola	MF	00220
	22 Regulus	MF	00220
	55	MN	00210
	* 16 Procyon	MN	00210
	* 64	MN	00210

* Alternate Stars to be used if other sightings cannot be made.

CSM 7-3.- Continued. 12/1/70 Final

TABLE II(b)

January 31, 1971 Launch Date

Sighting Schedule for Abort from Lunar Orbit

(GMT of EI = 10 February 1971, 21 Hours)

Time	Star	Horizon	R3
TEI + 1.5	23 Denebola	MF	00220
	30 Menkent	MN	00210
	170	MN	00210
	153	MF	00220
	165	MN	00210
TEI + 13	212	EF	00120
	33 Antares	EF	00120
	120	EN	00110
	*127	EF	00120
	* 76	EF	00120
TEI + 16	26 Spica	MN	00210
	22 Regulus	MF	00220
	151	MF	00220
	* 24 Gienah	MN	00210
	*156	MN	00210
TEI + 20	212	EF	00120
	33 Antares	EF	00120
	120	EN	00110
	*127	EF	00120
	* 76	EF	00120
TEI + 24	212	EF	00120
	33 Antares	EF	00120
	120	EN	00110
	*127	EF	00120
	* 76	EF	00120
TEI + 28	212	EF	00120
	33 Antares	EF	00120
	120	EN	00110
	*125	EF	00120
	* 76	EF	00120

CSM 7-3.- Concluded. 12/1/70 Final

TABLE II(b)

January 31, 1971 Launch Date
Sighting Schedule for Abort from Lunar Orbit
(GMT of EI = 10 February 1971, 21 Hours)
(Concluded)

Time	Star	Horizon	R3
EI - 32	212	EF	00120
	33 Antares	EF	00120
	125	EF	00120
	* 37 Nunki	EF	00120
	* 76	EF	00120
EI - 28	212	EF	00120
	33 Antares	EF	00120
	125	EF	00120
	* 37 Nunki	EF	00120
	* 76	EF	00120
EI - 23	212	EF	00120
	125	EF	00120
	37 Nunki	EF	00120
	* 76	EF	00120
	* 77	EF	00120
EI - 20	212	EF	00120
	125	EF	00120
	37 Nunki	EF	00120
	* 76	EF	00120
	* 77	EF	00120
EI - 11	212	EF	00120
	37 Nunki	EF	00120
	45 Formalhaut	EN	00110
	*213	EF	00120
	*235	EF	00120
EI - 5	156	MN	00210
	16 Procyon	MF	00220
	23 Denebola	MN	00210
	24 Gienah	MN	00210
	50	MF	00220
EI - 2.5	156	MN	00210
	16 Procyon	MF	00220
	23 Denebola	MN	00210
	*160	MN	00210
	* 50	MF	00220

* Alternate Stars to be used if other sightings cannot be made.

Pixley/MPB/MPAD (for G and C Checklist)
Data source PP
Data confirmed

CSM 7-4.- Comm loss during nominal TEC.

Launch day dependent
Launch month dependent
Mission profile dependent
January 31 launch date
12/1/70 Final

TABLE III.- COMM LOSS DURING NOMINAL TEC

W-MATRIX REINITIALIZATION

a. COMM LOSS PRIOR TO TIME FOR NAV STG BATCH 1
R1 + 30000
R2 + 00300
R3 + 00003

b. COMM LOSS AFTER TIME FOR NAV STG BATCH 1
AND NO SV UPDATE AFTER TEI
R1 + 99000
R2 + 00020
R3 + 00003

c. COMM LOSS AFTER TIME FOR NAV STG BATCH 1
AND AT LEAST ONE SV UPDATE AFTER TEI
R1 + 45000
R2 + 00006
R3 + 00003

January 31, 1971 Launch Date

Sighting Schedule for Nominal Transearth Coast (GMT of EI = 9 February 1971, 20 hrs, 46 min, 50 sec)

Time	Star	Horizon	R3
TEI + 1	26 (SPICA)	MN	00210
	22 (REGULUS)	MF	00220
	24 (GIENAH)	MN	00210
	151	MF	00220
	156	MN	00210
TEI + 15	212	EF	00120
	33 (ANTARES)	EF	00120
	40 (ALTAIR)	EN	00110
	* 77	EF	00120
	*125	EF	00120
TEI + 17.5	16 (PROCYON)	MF	00220
	22 (REGULUS)	MN	00210
	50	MF	00220
	* 67	MF	00220
	*153	MN	00210
TEI + 18	212	EF	00120
	33 (ANTARES)	EF	00120
	40 (ALTAIR)	EN	00110
	*201	EF	00120
	*125	EF	00120

CSM 7-4.- Concluded. 12/1/70 Final

TABLE III

January 31, 1971 Launch Date
Sighting Schedule for Nominal Transearth
Coast (GMT of EI = 9 February 1971, 20 hrs, 46 min, 50 sec)
(Concluded)

Time	Star	Horizon	R3
TEI + 24	212	EF	00120
	33 (ANTARES)	EF	00120
	40 (ALTAIR)	EN	00110
	*201	EF	00120
	*125	EF	00120
EI - 28	33 (ANTARES)	EF	00120
	120	EN	00110
	37 (NUNKI)	EF	00120
	* 77	EF	00120
	*127	EF	00120
EI - 24	33 (ANTARES)	EF	00120
	120	EN	00110
	37 (NUNKI)	EF	00120
	* 77	EF	00120
	*127	EF	00120
EI - 20	33 (ANTARES)	EF	00120
	120	EN	00110
	37 (NUNKI)	EF	00120
	* 77	EF	00120
	*125	EF	00120
EI - 8	45 (FORMALHAUT)	EN	00110
	212	EF	00120
	213	EF	00120
	44 (ENIF)	EN	00110
	* 37 (NUNKI)	EF	00120
	*235	EF	00120
EI - 5	23 (DENEBOLA)	MF	00220
	22 (REGULUS)	MF	00220
	16 (PROCYON)	MN	00210
	64	MN	00210
	151	MF	00220
EI - 2.5	23 (DENEBOLA)	MF	00220
	22 (REGULUS)	MF	00220
	16 (PROCYON)	MN	00210
	* 64	MN	00210
	*151	MF	00220

* Alternate Stars

Pixley/MPB/MPAD (for G and C Checklist) Mission independent
Data source PP
Data confirmed PP

CSM 7-5.- Do-it-yourself sighting schedule. 12/1/70 Final Revision 1

TABLE IV - DO-IT-YOURSELF

1. ABORTS FROM TLC

W-MATRIX INITIALIZATION

R1 + 80000
R2 + 00070
R3 + 00003

NAVIGATION SCHEDULE

ΔT TO EI <20 hrs
BATCHES OF 3 SETS EVERY 2.5 hrs
BATCH OF 5 SETS AT EI-5
(BEFORE LAST MCC AT EI-3)
BATCH OF 3 SETS AFTER LAST MCC

ΔT >20 hrs
SLEEP PERIODS OF 8 HOURS MAY BE SCHEDULED.
CREW SHOULD BE AWAKE LAST 10 HOURS PRIOR TO EI.
WHILE AWAKE:
BATCHES OF 3 SETS EVERY 3 HRS
BATCHES OF 5 SETS AFTER SLEEP PERIODS
BATCH OF 5 SETS PRIOR TO LAST MCC (AT EI-3)
BATCH OF 3 SETS AFTER LAST MCC

NOTE - ONLY STAR/EARTH HORIZON MARKS WILL BE MADE.

2. FLYBY, ABORT FROM LUNAR ORBIT, TEC.

W-MATRIX INITIALIZATION

a. COMM LOSS BEFORE BATCH 1
(at TEI + 1 or perilune +1 hr)

R1 + 30000
R2 + 00300
R3 + 00003

TABLE IV - Continued

b. COMM LOS AFTER BATCH 1
(at TEI + 1 or perilune + 1 hr)
and
No SV update after TEI
R1 + 99000
R2 + 00020
R3 + 00003

c. COMM LOSS AFTER BATCH 1
(at TEI + 1 or perilune +1 hr)
and
At least one SV update
after TEI
R1 + 45000
R2 + 00006
R3 + 00003

NAVIGATION SCHEDULE

A. RETURN LENGTH >70 hrs

1 Refer to Table III for placement of batches of star/horizon sightings and relate the times given at "TEI +" and "EI-" to the specific transearth situation. For each batch scheduled, take three marks on each available star (up to 5 stars).

2 Schedule three earth horizon sightings for every 5 hours between TEI + 32 and EI - 40 hours, or if an additional sleep period is needed for very slow returns, schedule five earth horizon sightings before the sleep period and five earth horizon sightings upon awakening.

CSM 7-5.- Concluded. 12/1/70 Final Revision

TABLE IV - (Concluded)

B. RETURN LENGTH <70 hrs

1 Sleep periods of 8 hours should be provided. Astronauts should be awake the last 10 hours before entry interface.

2 Three sets of star horizon observations should be scheduled every three hours while awake with five sets scheduled before and after each sleep period.

(a) A batch of lunar horizon sightings should be taken at TEI + 1 hour or perilune + 1 hour.

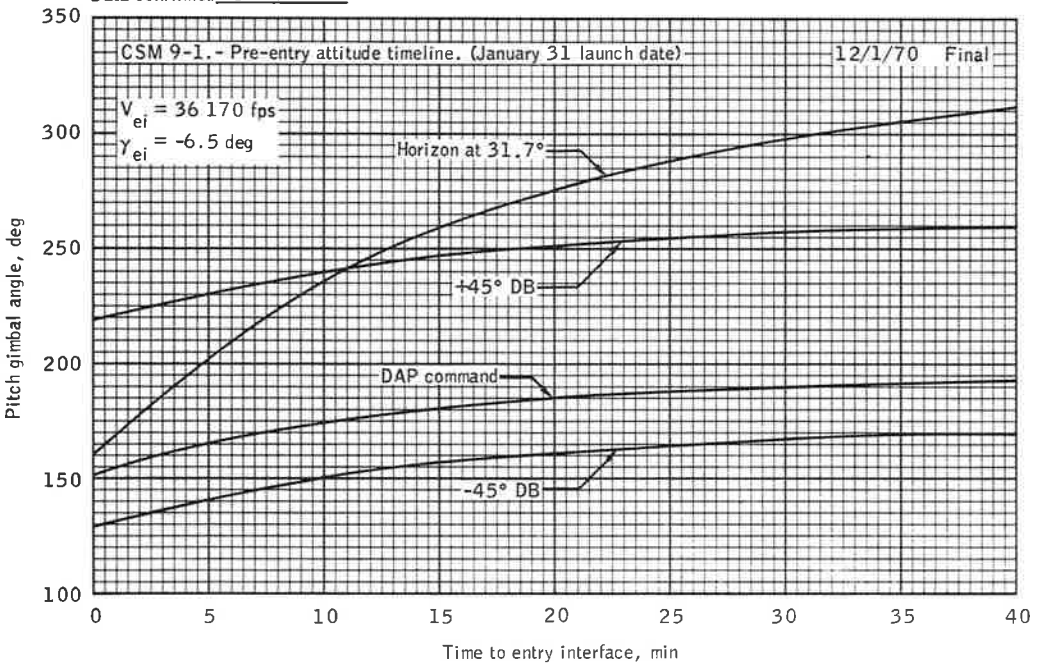
(b) The second batch of data should consist of earth horizon sightings.

(c) The third batch of data should consist of lunar horizon sightings.

(d) The remainder of the data should be earth horizon sightings. If no earth horizon sightings are available, lunar horizon sightings should be substituted.

3 Five earth/horizon sets should be scheduled at EI-5 hours before the MCC at EI = 3 hours. Three sets should be taken after the midcourse. If no earth horizon sightings are available, lunar horizon sightings should be substituted.

Heath/LAB/MPAD (for Entry Checklist and CSM Cue Cards) Mission profile dependent
Data source MSC I.N. 70-FM-71
Data confirmed Draft



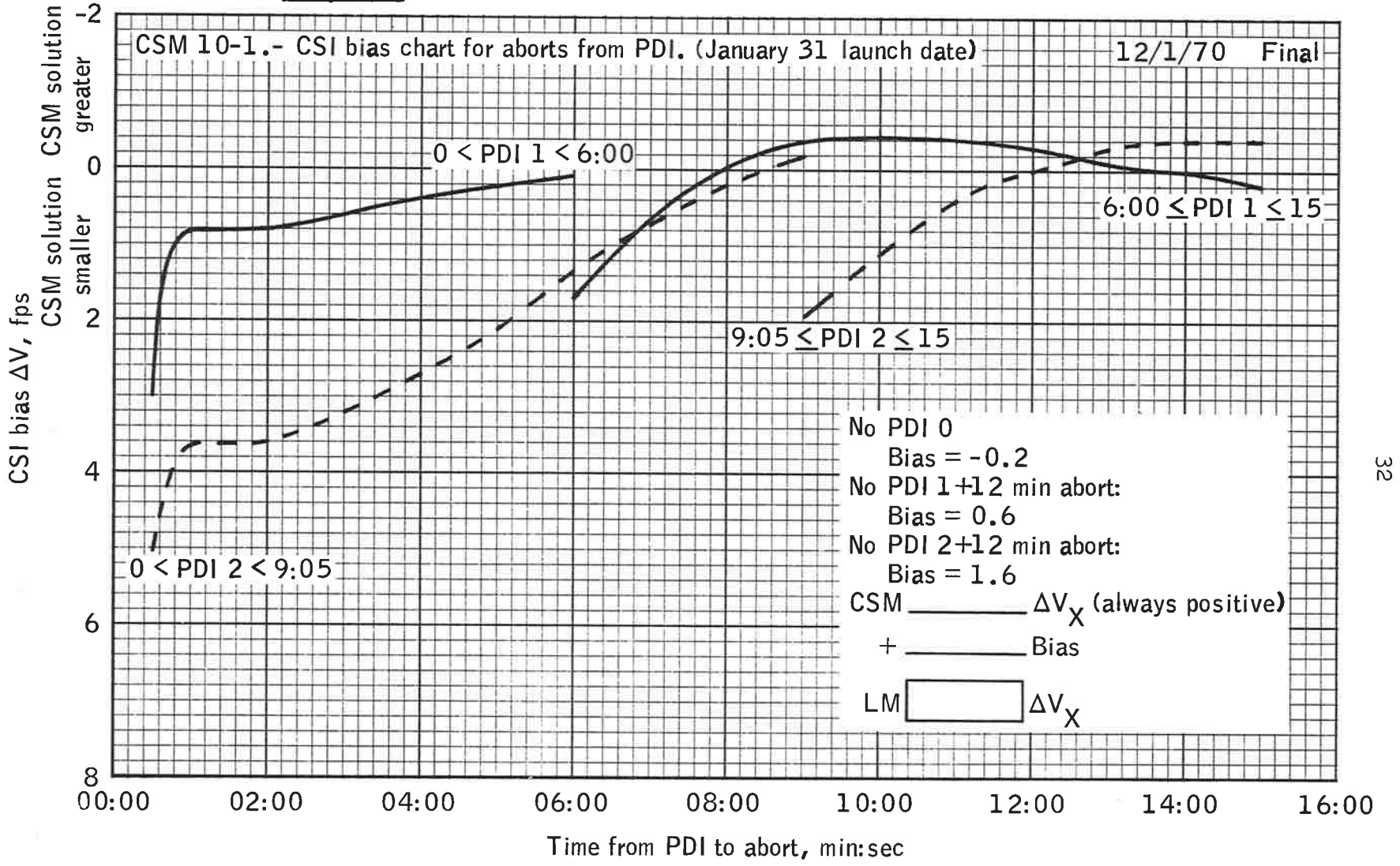
Pre-entry attitude timeline.

DuPont/OMAB/MPAD (for CSM Rescue LM Timeline)

Data source SC O.T.

Data confirmed A.Z.D.

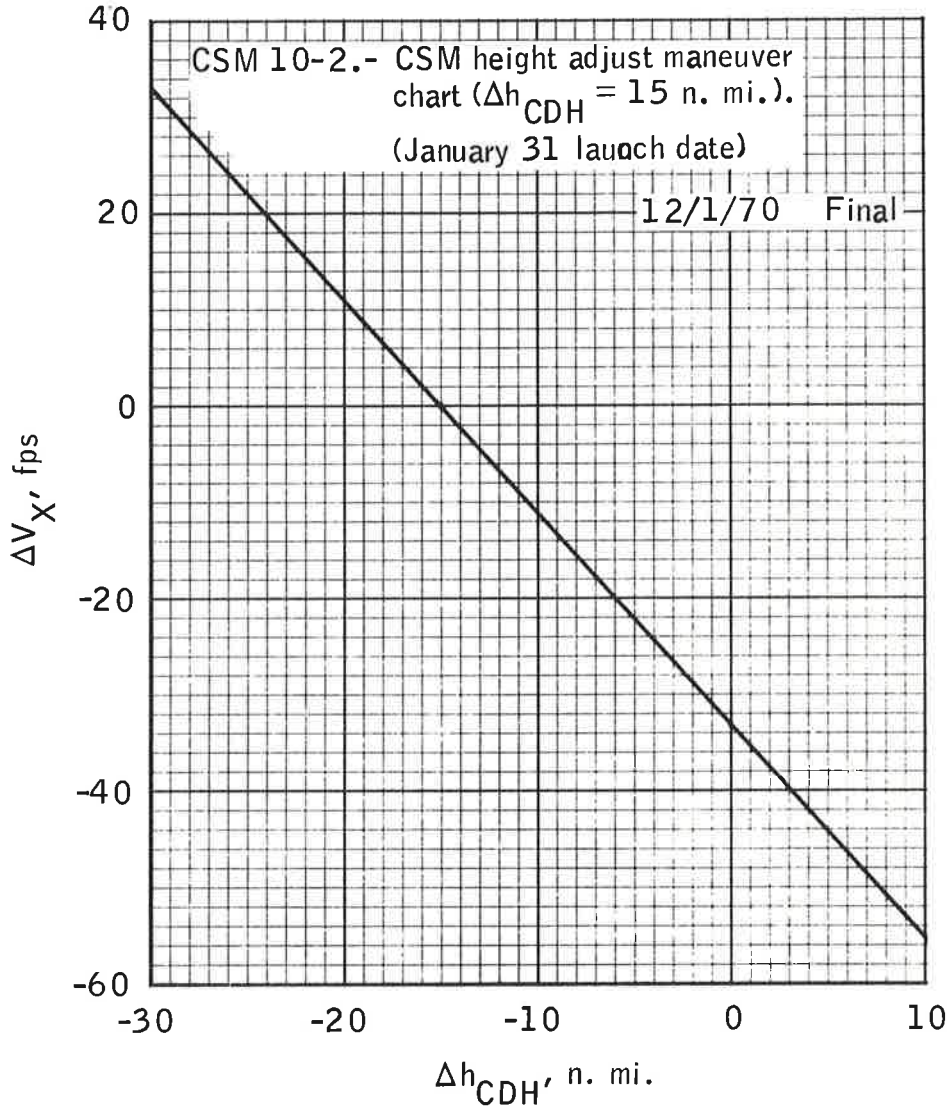
Mission profile dependent



CSI bias chart for aborts from PDI.

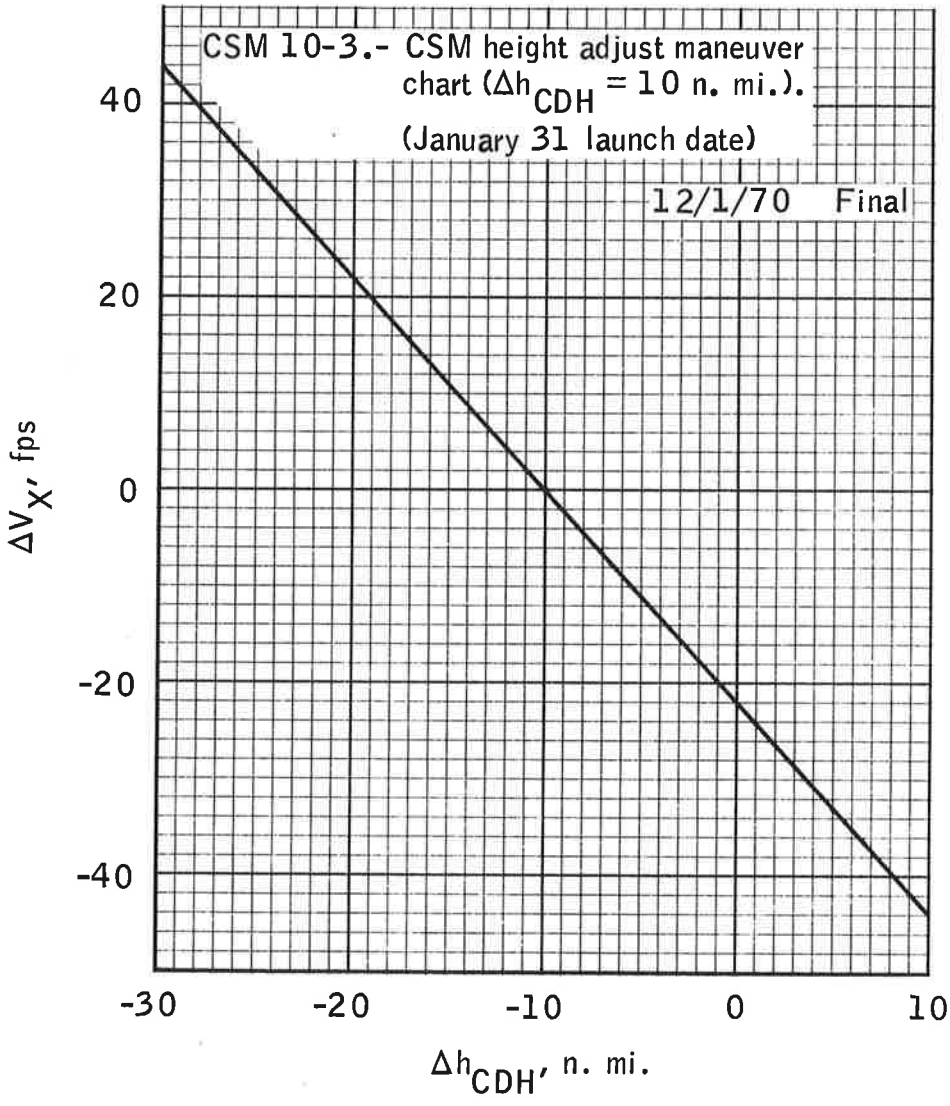
DuPont/OMAB/MPAD (for CSM Rescue)
Data source S.C. O.T.
Data confirmed J.Y.D.

Mission profile dependent



CSM height adjust maneuver chart
(Δh_{CDH} = 15 n. mi.).

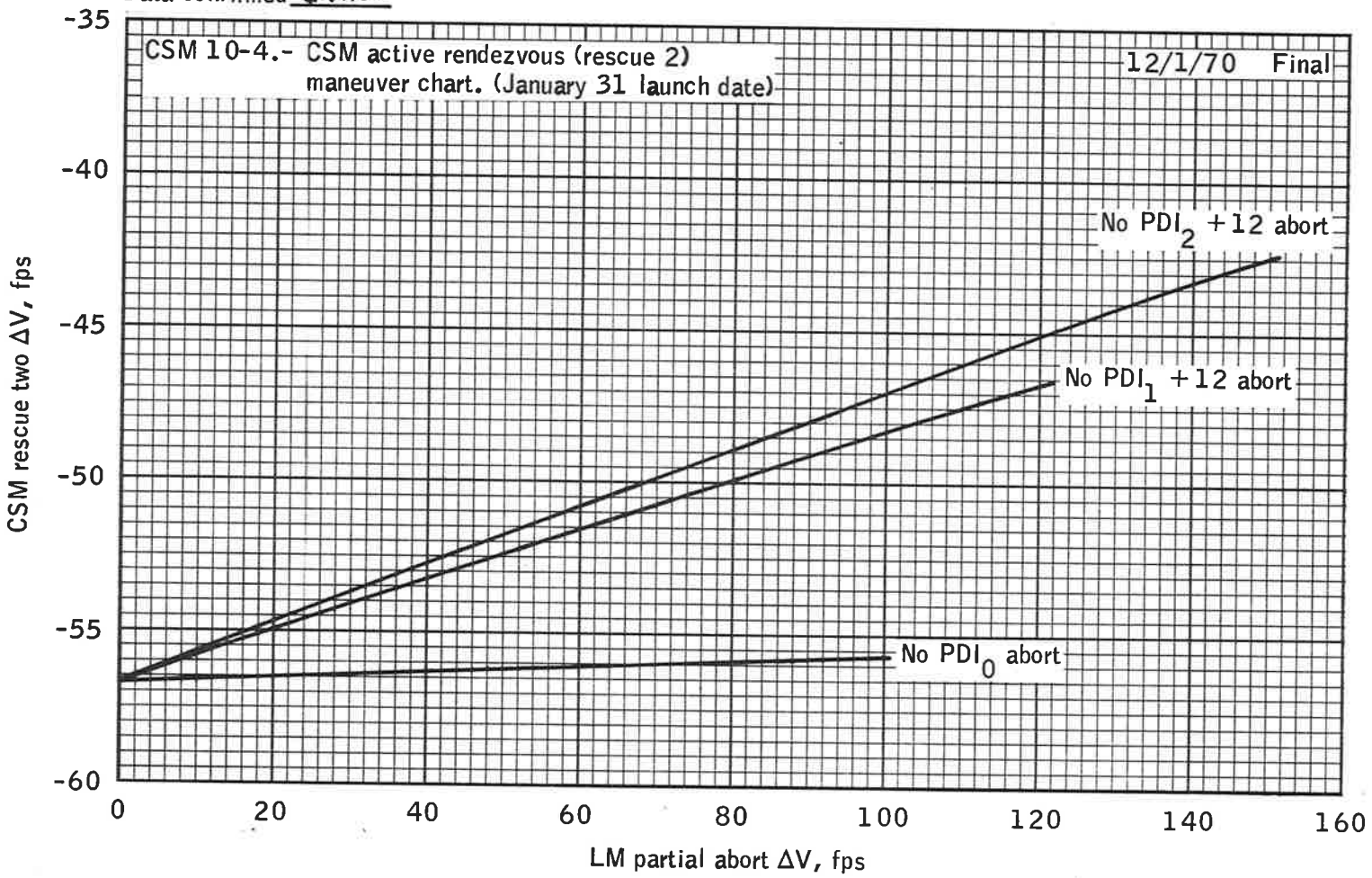
DuPont/OMAB/MPAD (for CSM Rescue) Mission profile dependent
Data source SC O.T.
Data confirmed A.L.D.



CSM height adjust maneuver chart
(Δh_{CDH} = 10 n. mi.).

DuPont/OMAB/MPAD (for CSM Rescue)
Data source SC O.T.
Data confirmed Q.L.D.

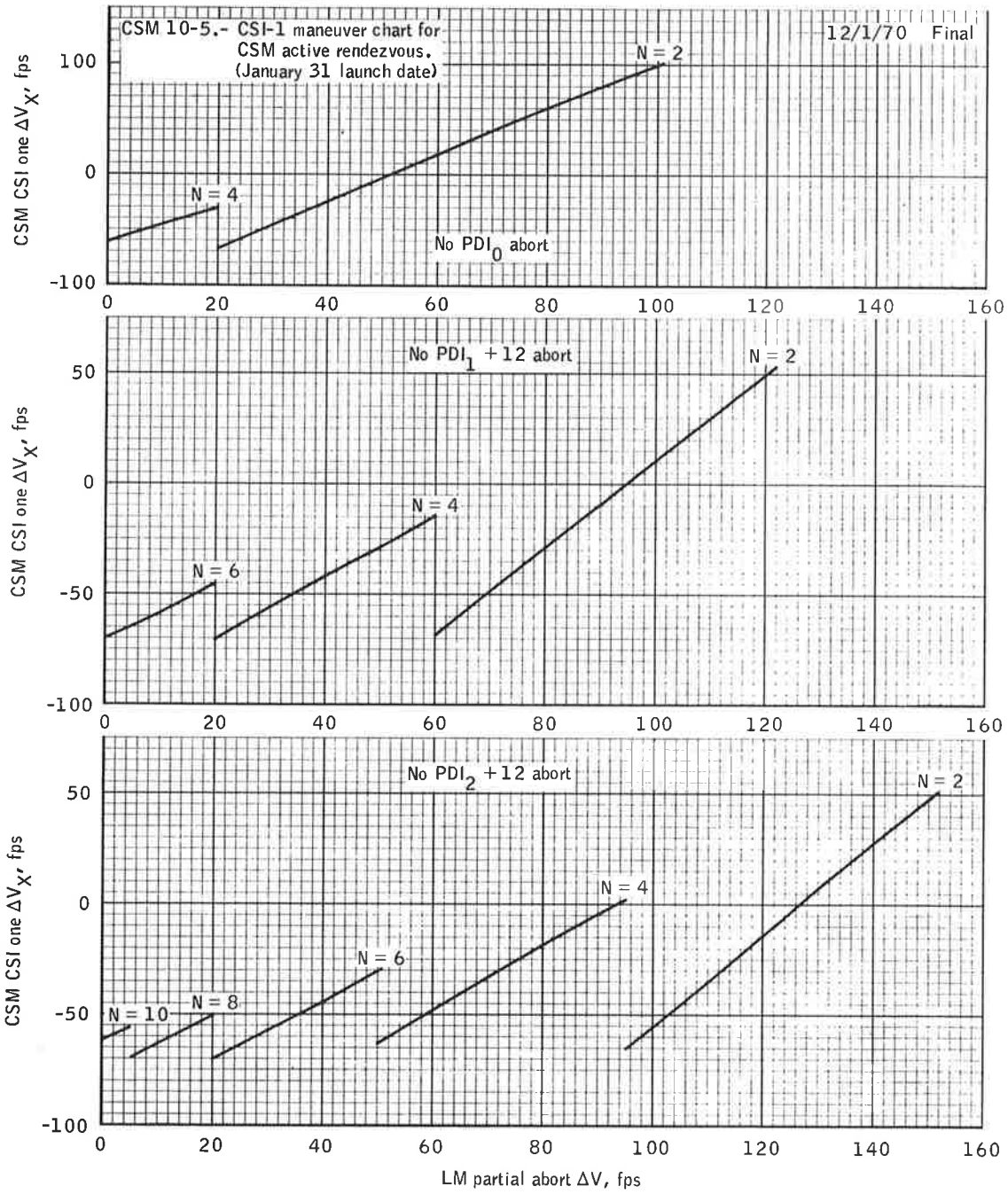
Mission profile dependent



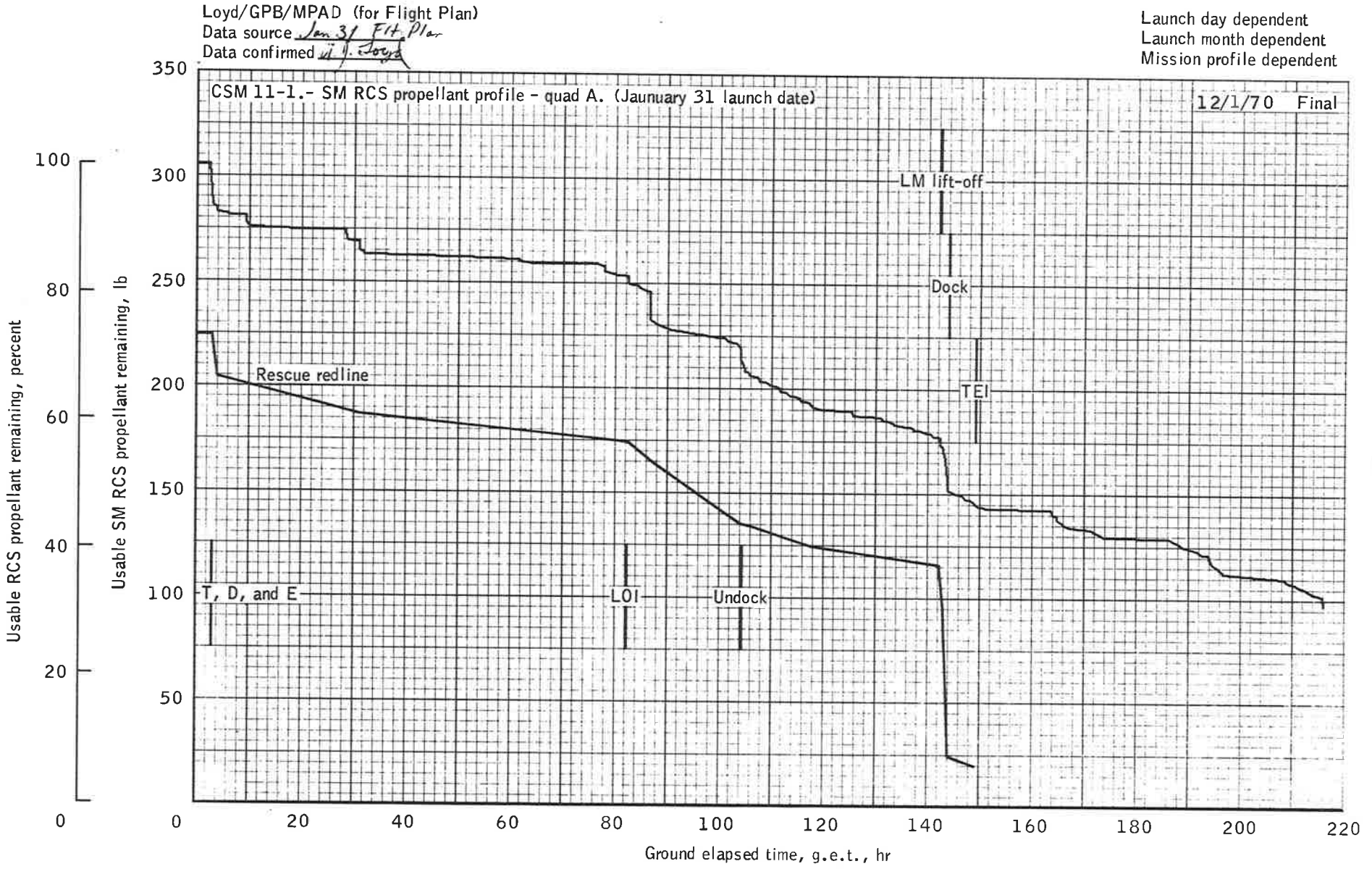
CSM active rendezvous (rescue 2) maneuver chart.

DuPont/OMAB/MPAD (for CSM Rescue)
Data source SC O.T.
Data confirmed A.C.D.

Mission profile dependent



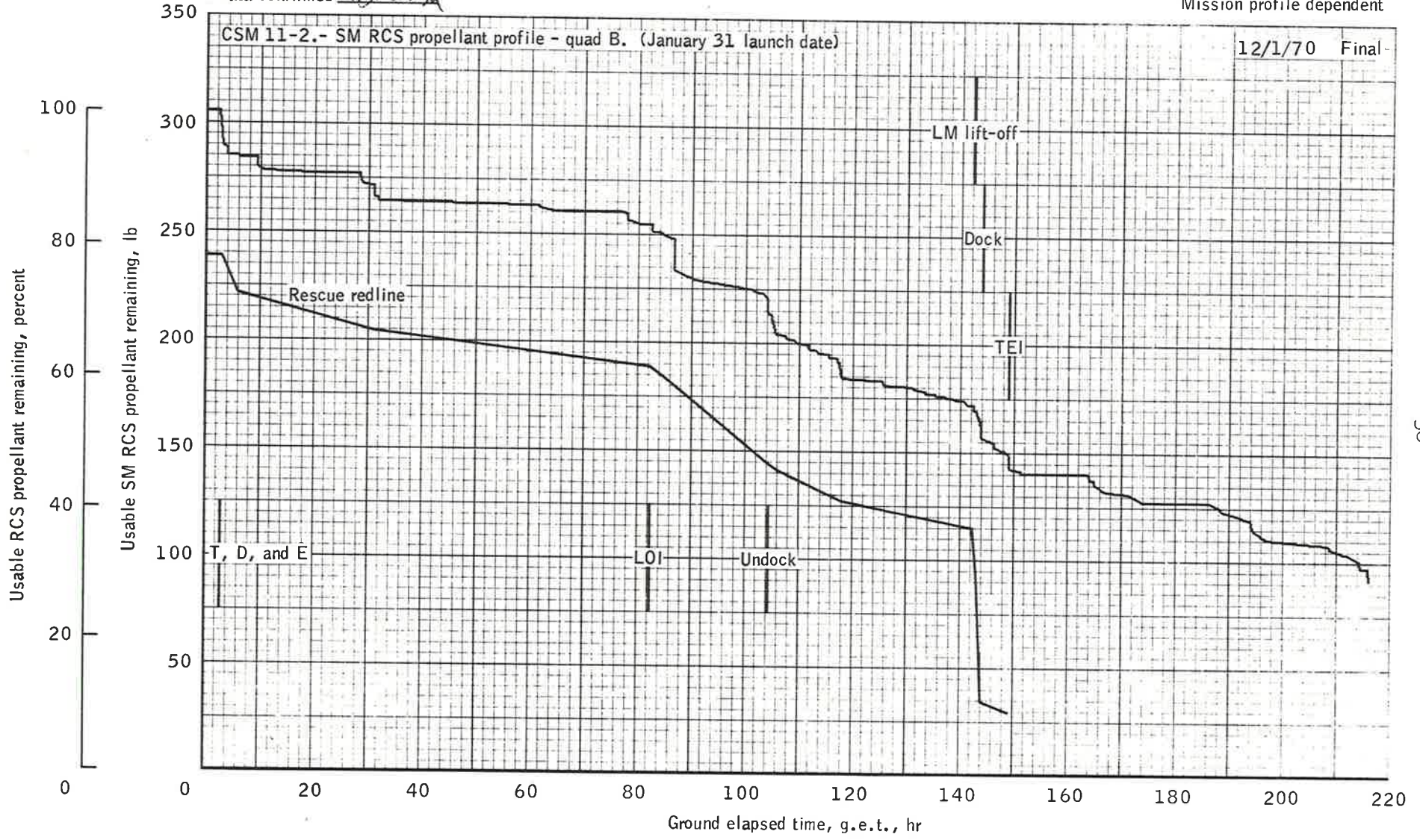
CSI-1 maneuver chart for CSM active rendezvous.



SM RCS propellant profile - quad A.

Loyd/GPB/MPAD (for Flight Plan)
Data source Jan 31 Flt Plan
Data confirmed E.J. Loyd

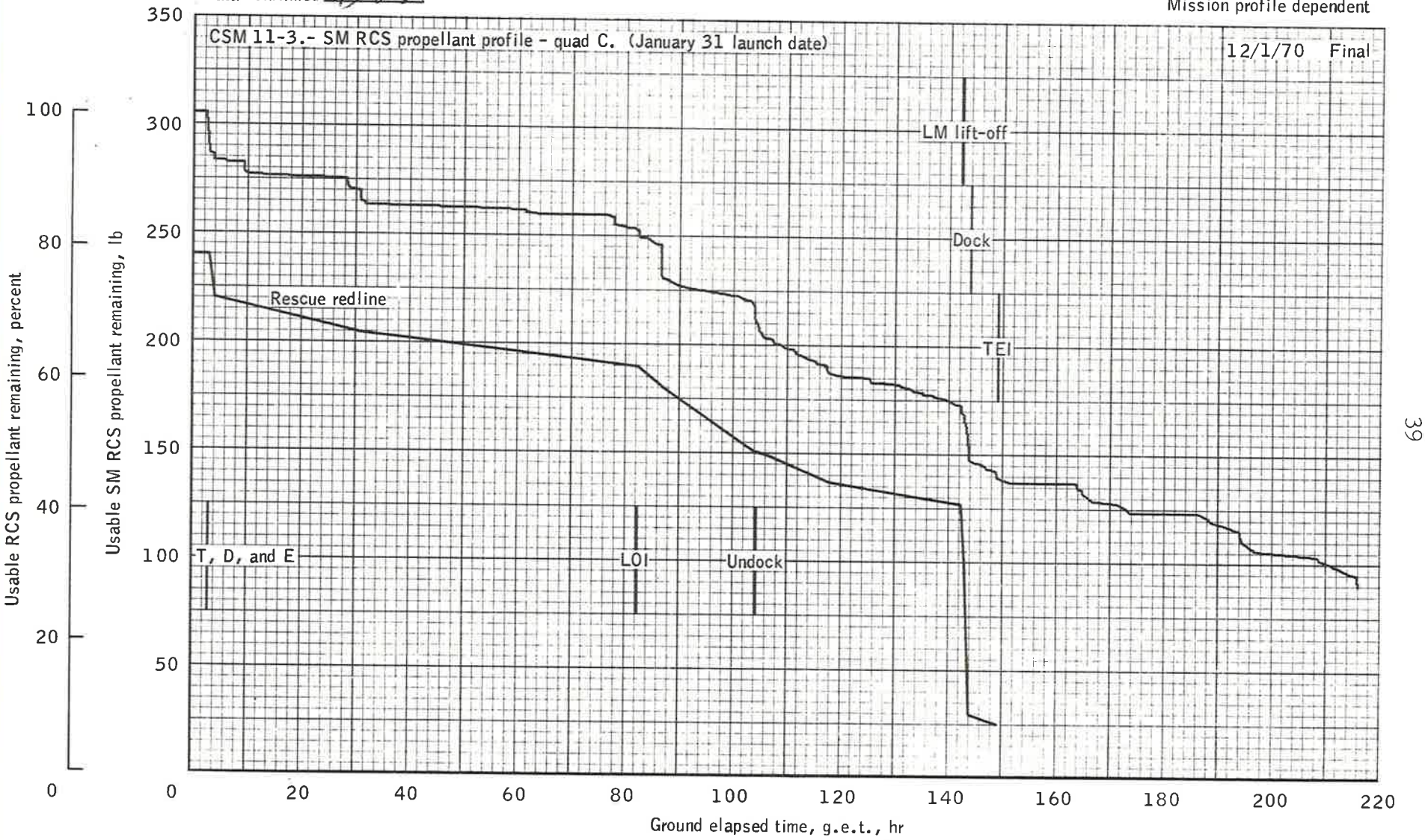
Launch day dependent
Launch month dependent
Mission profile dependent



SM RCS propellant profile - quad B.

Loyd/GPB/MPAD (for Flight Plan)
Data source Jan 31 Flt. Plan
Data confirmed CJ 1-30-71

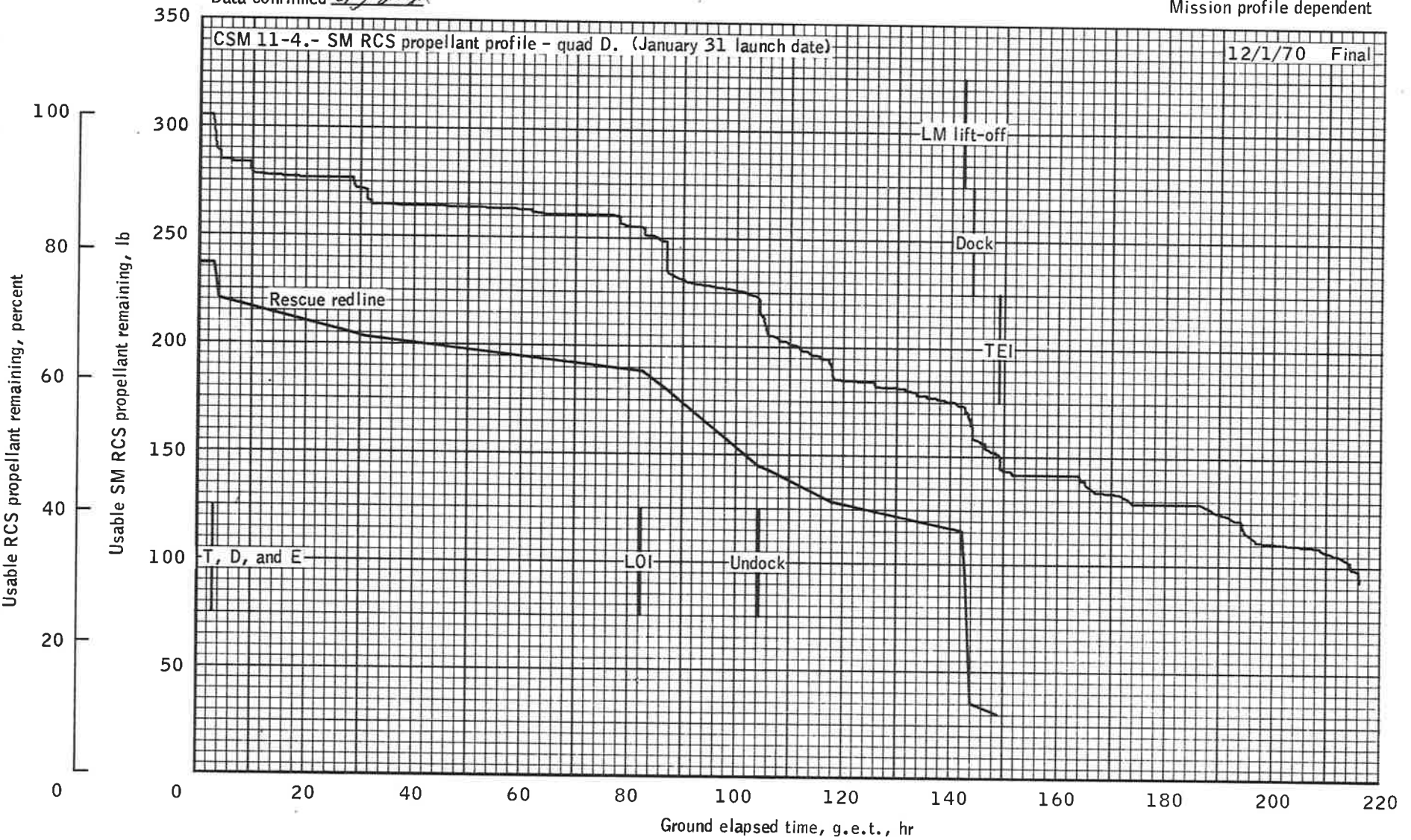
Launch day dependent
Launch month dependent
Mission profile dependent



SM RCS propellant profile - quad C.

Loyd/GPB/MPAD (for Flight Plan)
Data source Ja. 31 Flt. Plan
Data confirmed A J Loyd

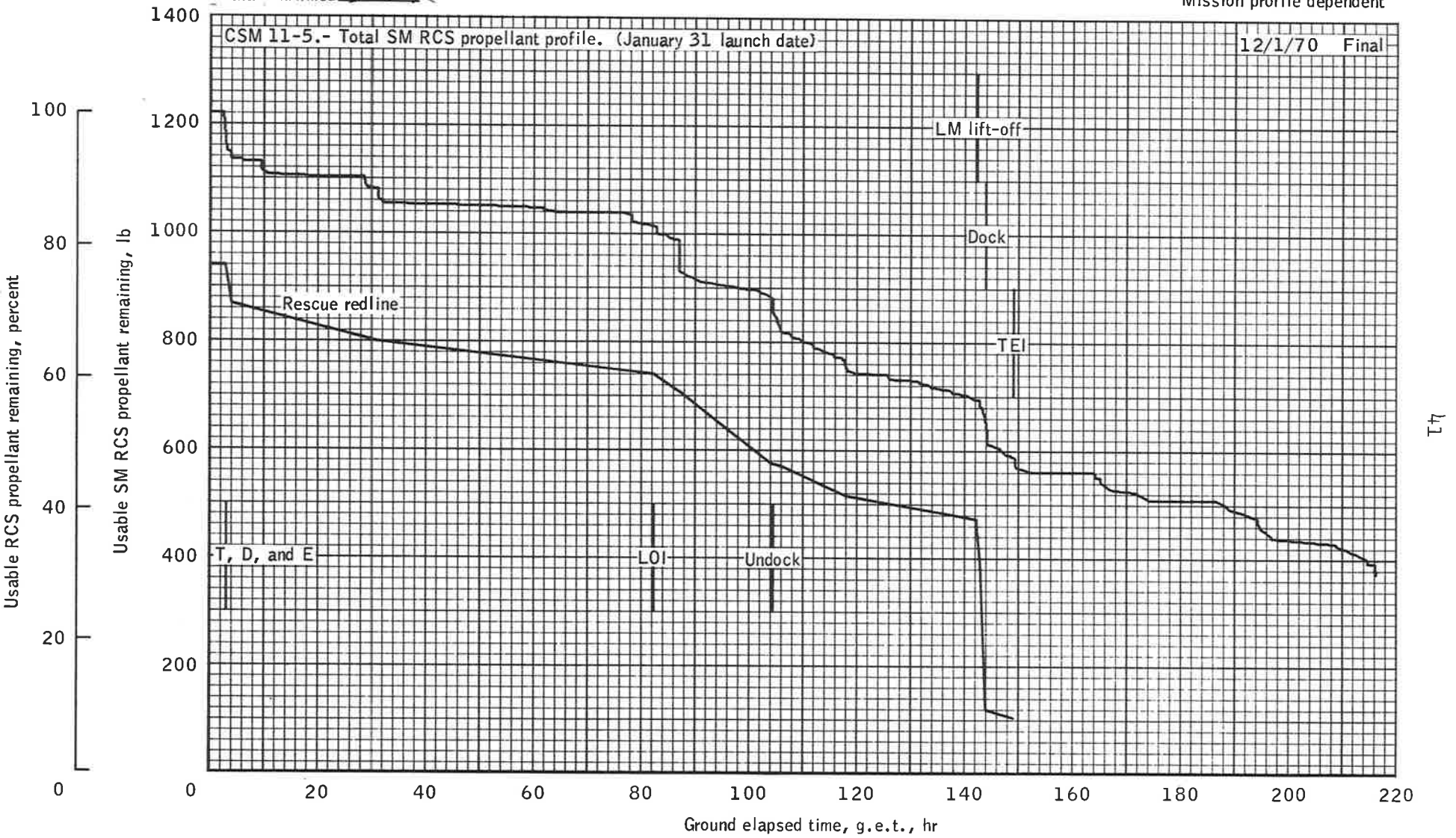
Launch day dependent
Launch month dependent
Mission profile dependent



SM RCS propellant profile - quad D.

Loyd/GPB/MPAD (for Flight Plan)
Data source Jan 31 F.lt. Plan
Data confirmed J. Loyd

Launch day dependent
Launch month dependent
Mission profile dependent

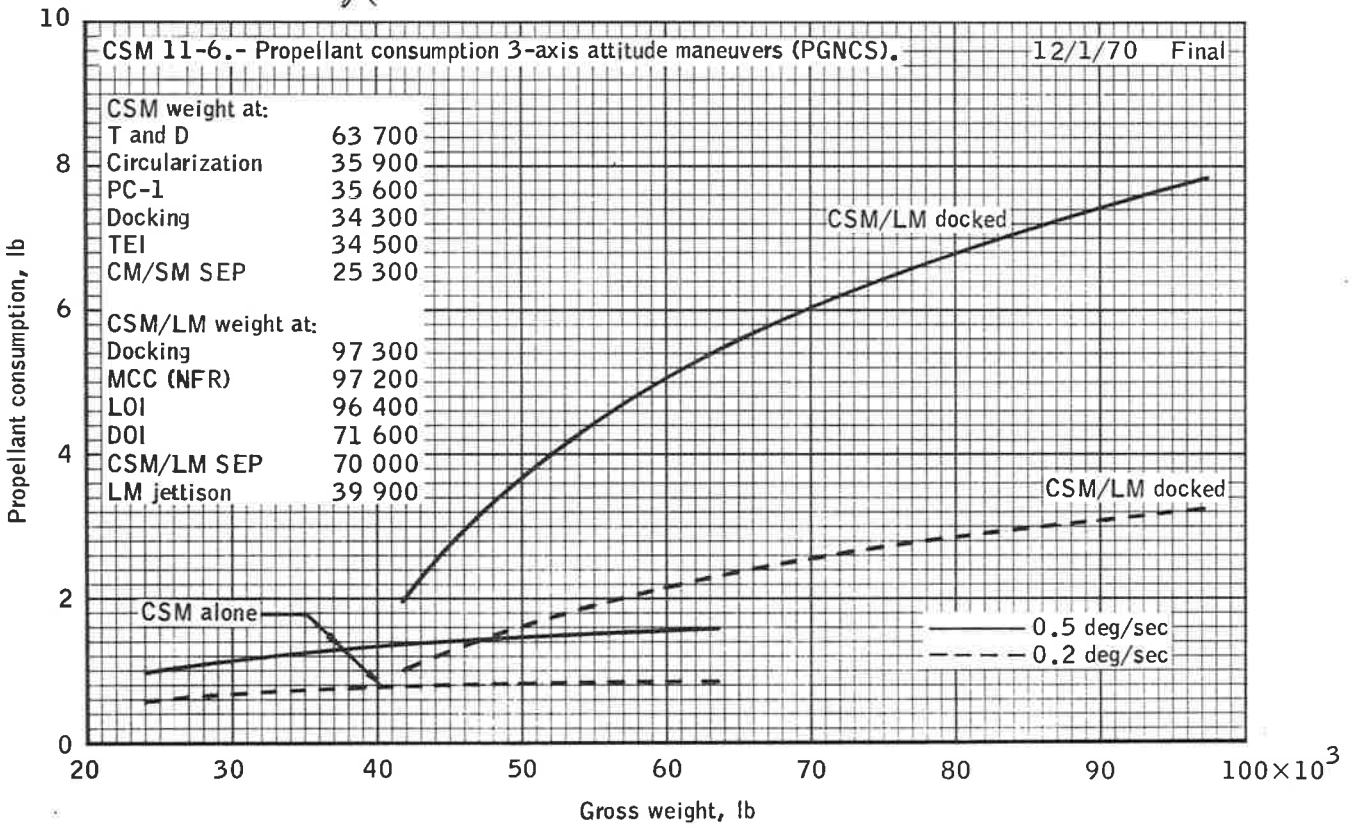


Total SM RCS propellant usage profile.

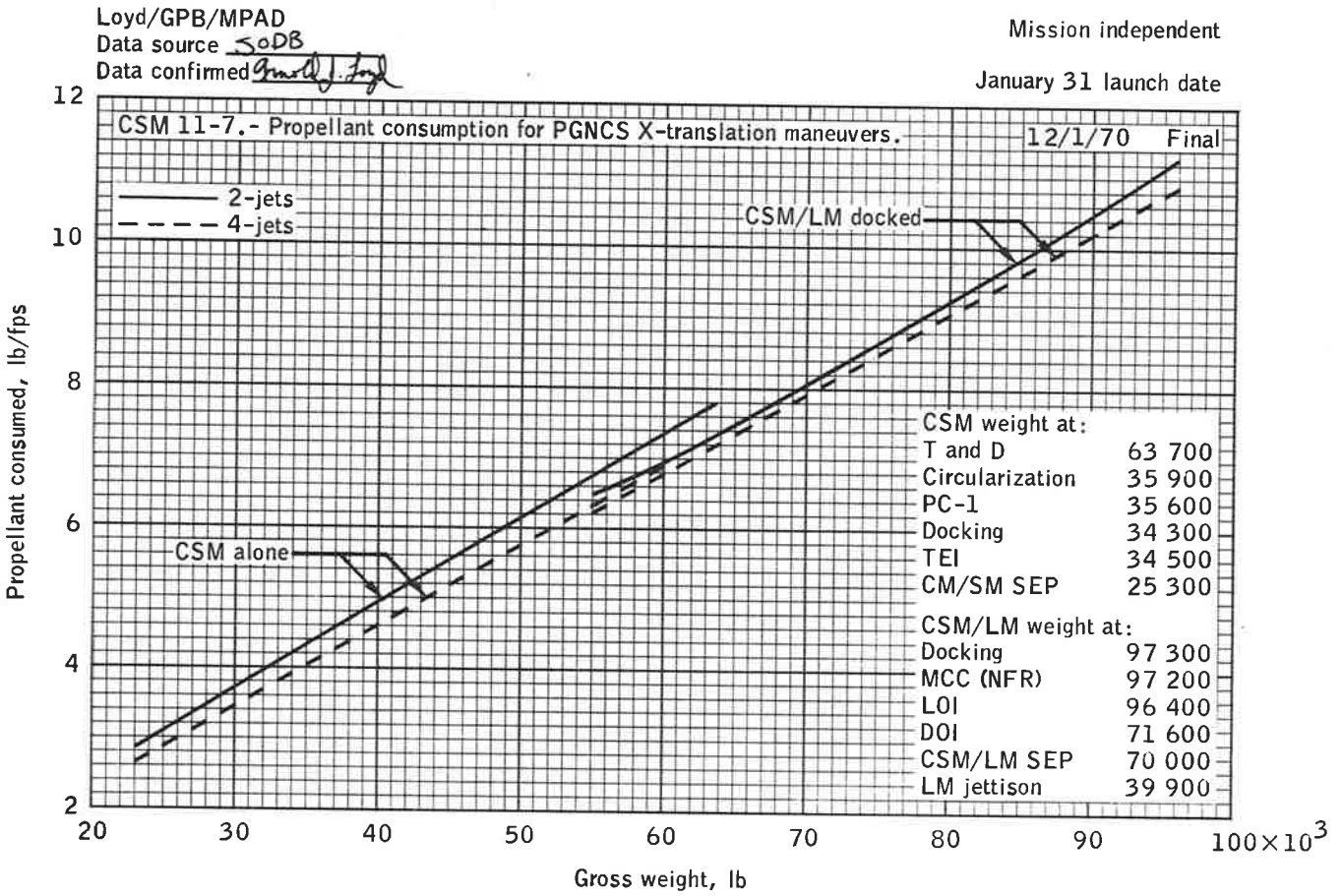
Loyd/GPB/MPAD (G and C Checklist)
Data source SODB
Data confirmed Arnold Loyd

Mission independent

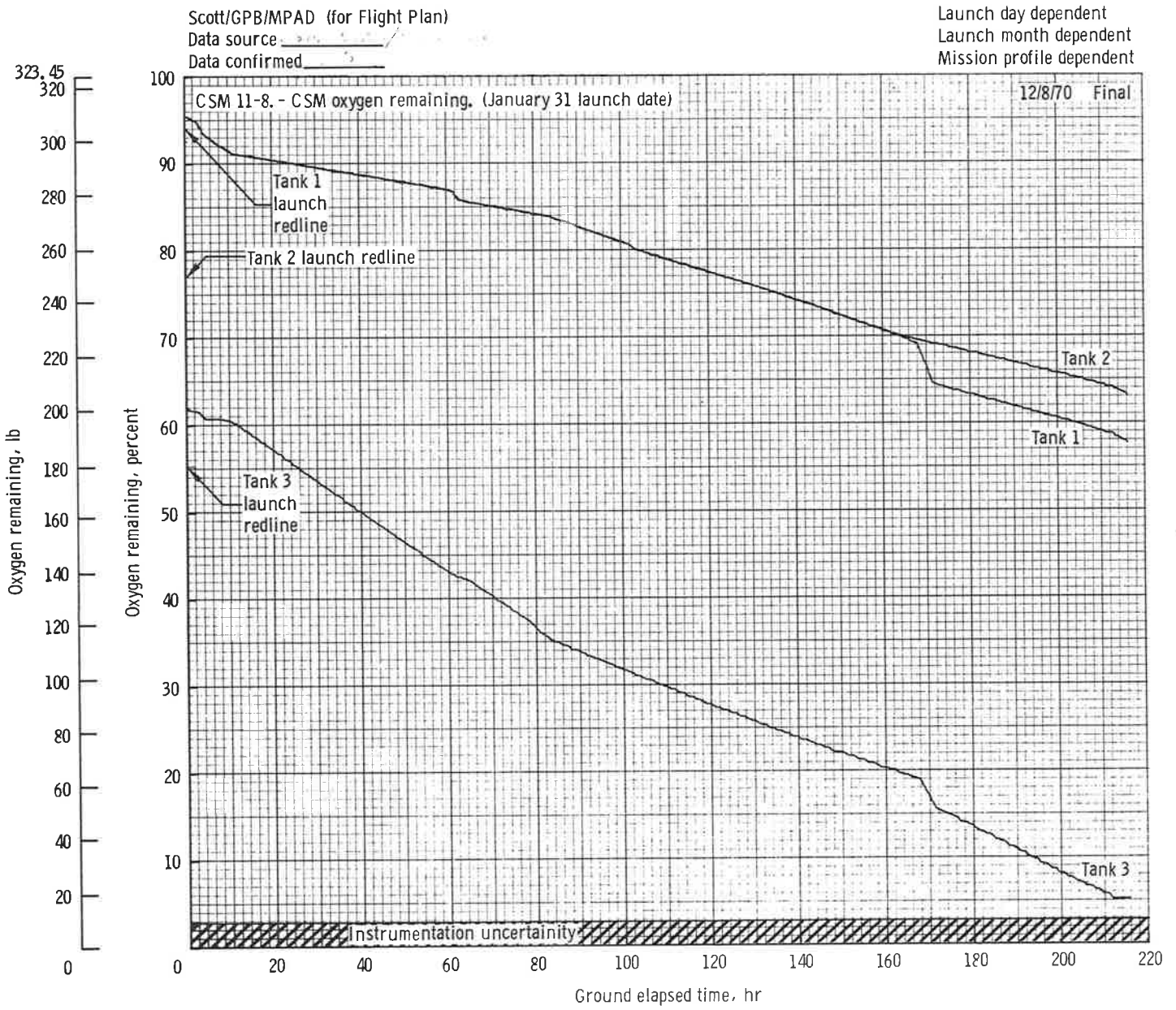
Jaunuary 31 launch date



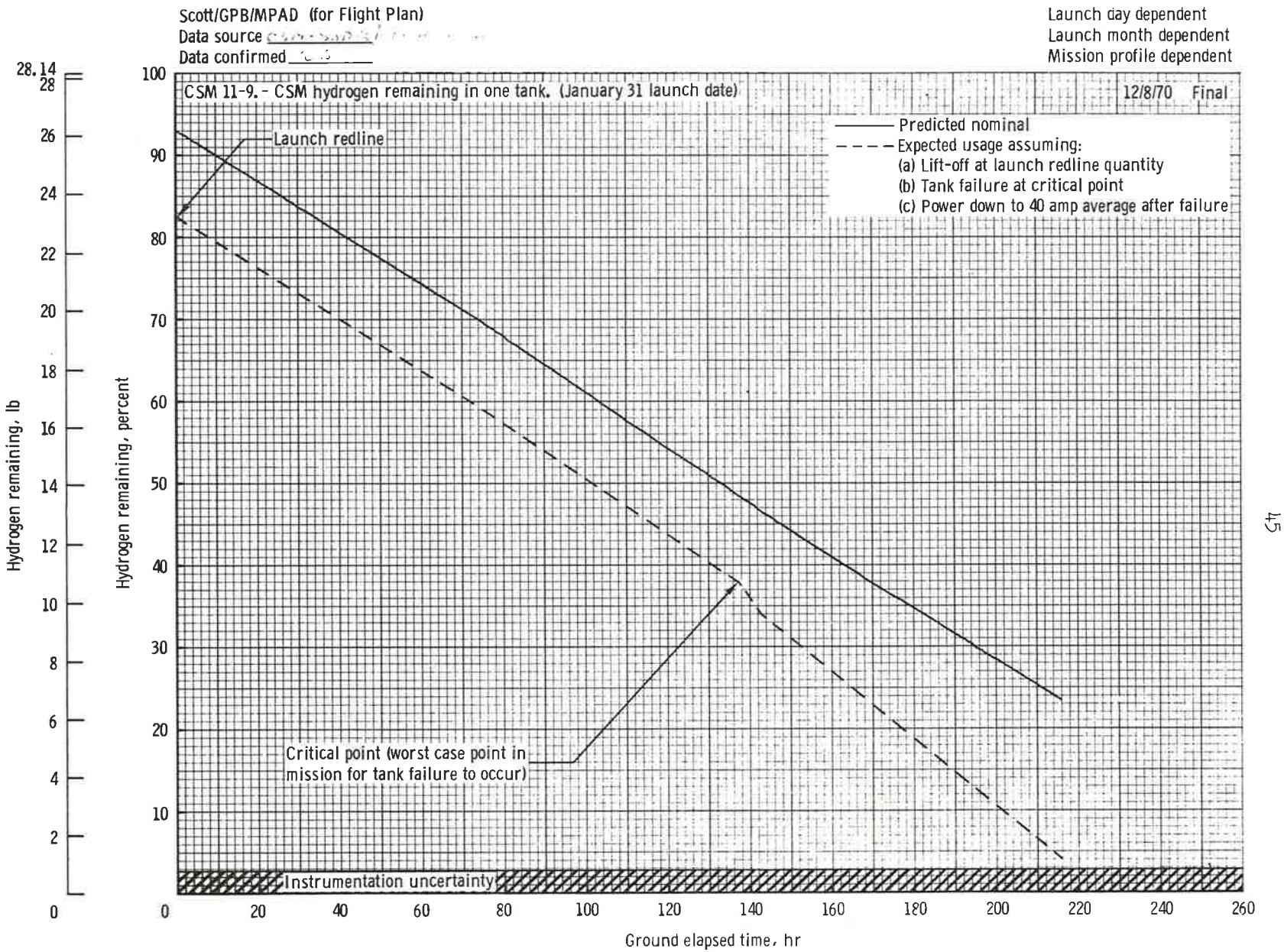
Propellant consumption 3-axis attitude maneuvers (PGNCS).



Propellant consumption for PGNCS X-translation maneuvers.



CSM oxygen remaining.



CSM hydrogen remaining in one tank.

Scott/GPB/MPAD (for Flight Plan) Mission profile dependent
Data source [illegible]
Data confirmed [illegible]

CSM 11-10.- Ground rules and assumptions for the CSM cryogenics. (January 31 launch date) 12/8/70 Final

GROUND RULES AND ASSUMPTIONS FOR THE CSM CRYOGENICS

1. Three O_2 tanks and two H_2 tanks are available.

2. Fuel cell purging is included in the EPS requirements.

3. Both H_2 tanks and two of the three O_2 tanks are assumed to be fully loaded. The third O_2 tank is to be off-loaded to approximately 62 percent at lift-off.

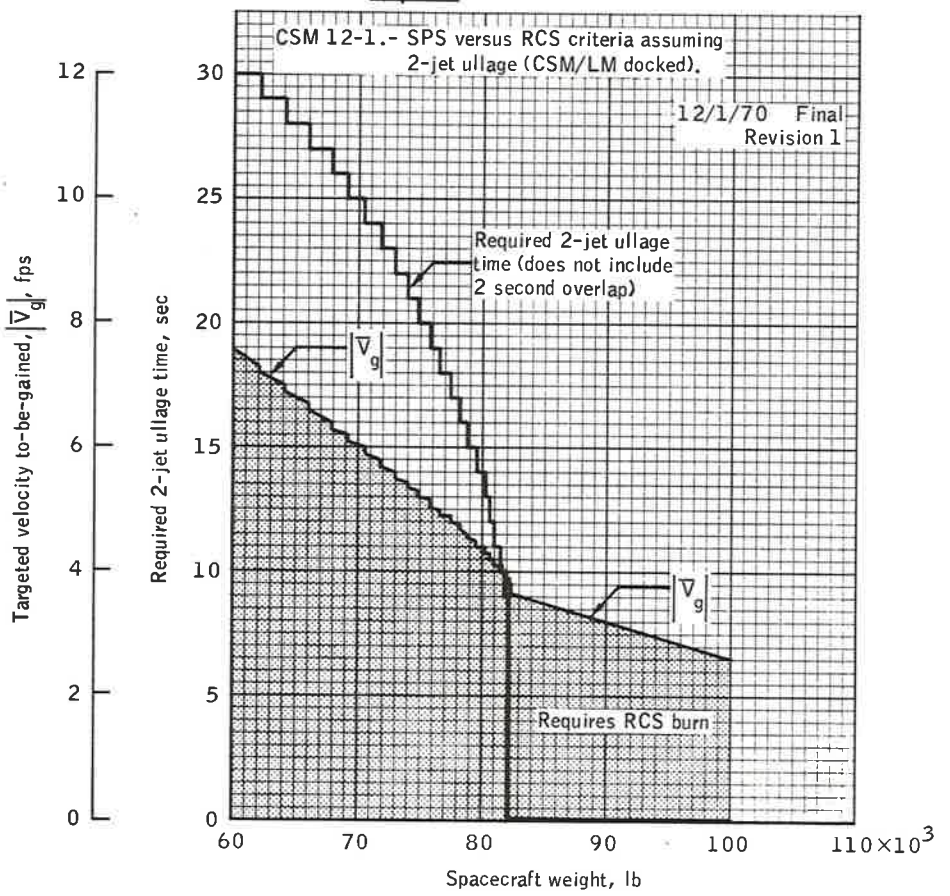
4. No cryogenic venting was assumed in flight.

5. The EPS hydrogen consumption rate ($\dot{H}_2$) (lb/hr) = $0.00257 \times I_{fc}$ when I_{fc} is the total fuel cell current.

6. The EPS oxygen consumption rate ($\dot{O}_2$) (lb/hr) = $7.936 \times \dot{H}_2$.

7. The launch redlines for O_2 are defined as points on the curve. These points are contingent upon accomplishing DTO 4.6 which is greater than a tank loss requirement. However, if lift-off were to occur at these points, a somewhat different tank management scheme would have to be employed, even if no tank failed. If a tank failure were to occur then a nominal 40 Amp return level plus ECS would be employed on the remaining two tanks.

Ford/GPB/MPAD (for G and C Checklist) Mission independent
Data source CSM Data Book (vol 1)
Data confirmed AKF



SPS versus RCS criteria assuming 2-jet ullage (CSM/LM docked).

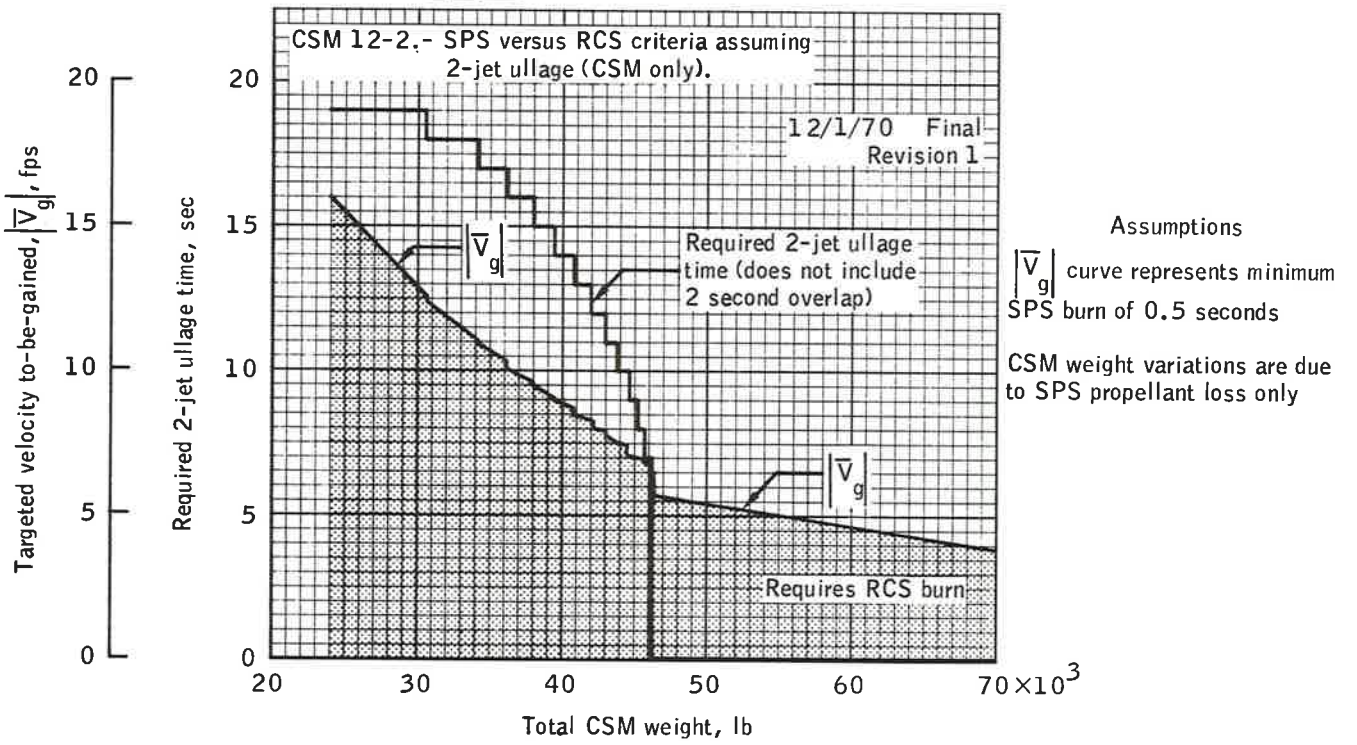
Assumptions

Spacecraft weight assumed to consist of CSM and fully loaded LM

$|\bar{V}_g|$ curve represents minimum SPS burn of 0.5 seconds

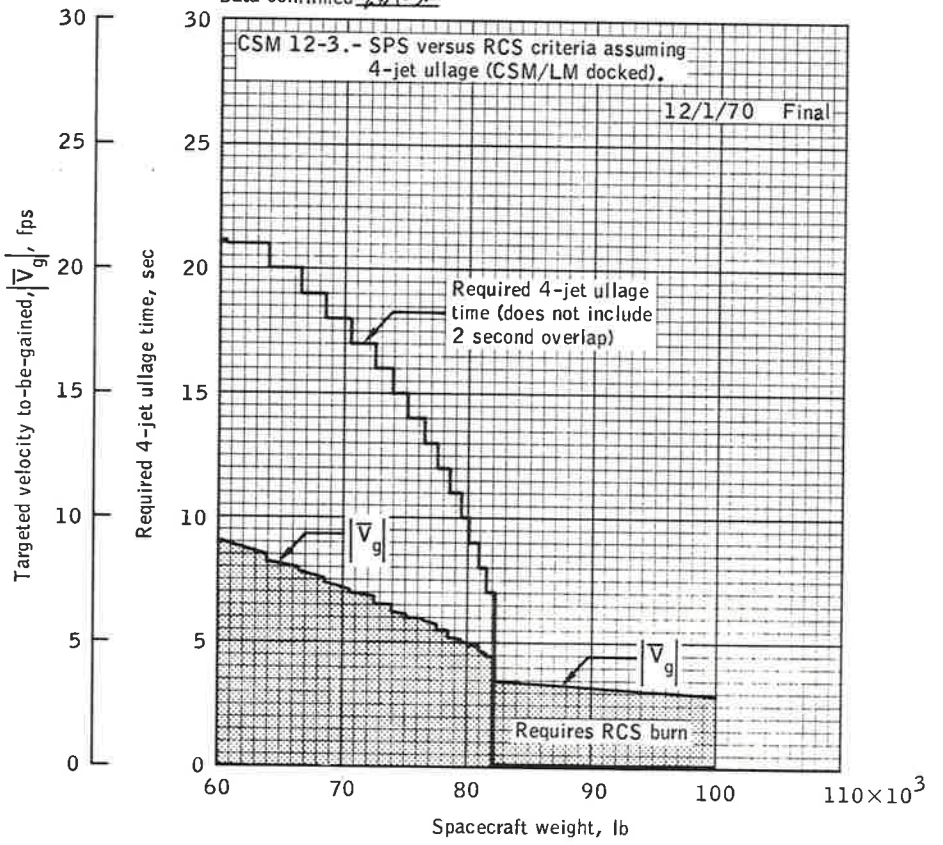
CSM weight variations are due to SPS propellant loss only

Ford/GPB/MPAD (for G and C Checklist) Mission independent
Data source CSM Data Book (Vol 3)
Data confirmed A.K.F.



SPS versus RCS criteria assuming 2-jet ullage (CSM only).

Ford/GPB/MPAD (for G and C Checklist) Mission independent
Data source CSM Data Book (Vol 4)
Data confirmed AK-FF



SPS versus RCS criteria assuming 4-jet ullage (CSM/LM docked).

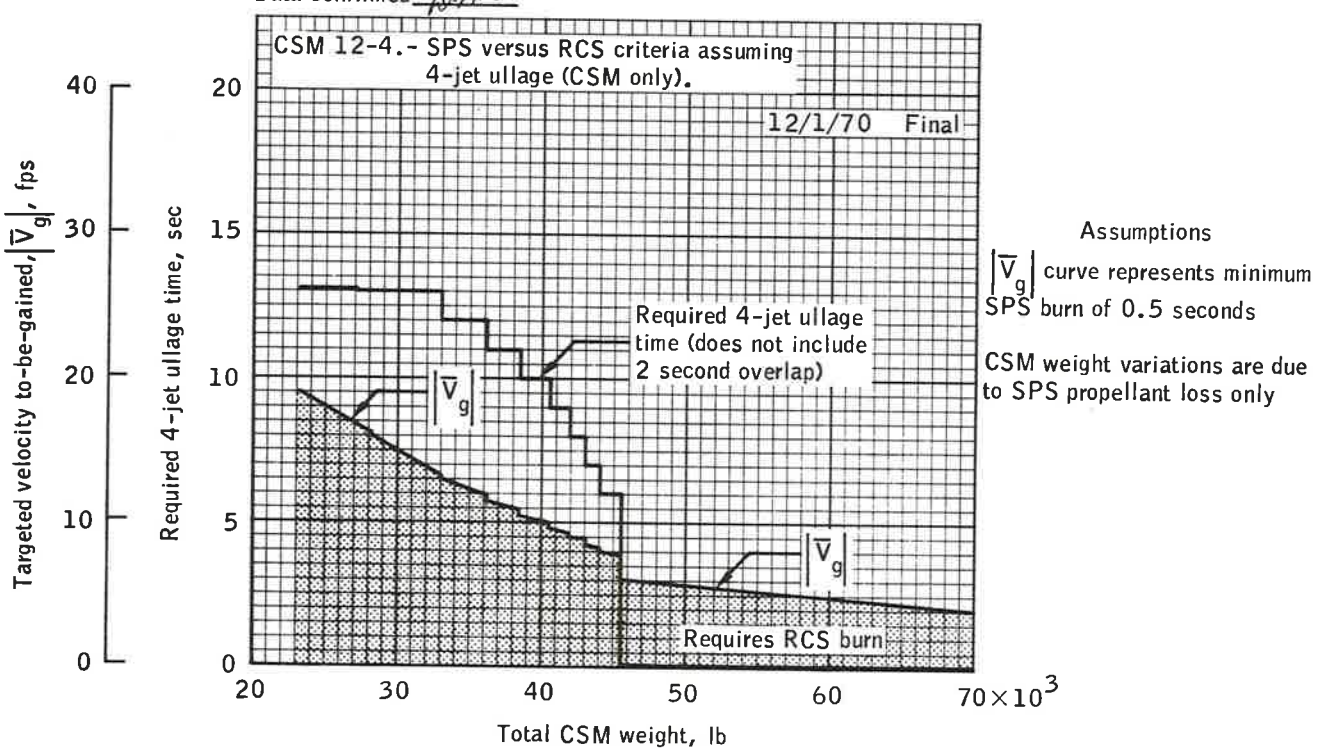
Assumptions

Spacecraft weight assumed to consist of CSM and fully loaded LM

$|\bar{V}_g|$ curve represents minimum SPS burn of 0.5 seconds

CSM weight variations are due to SPS propellant loss only

Ford/GPB/MPAD (for G and C Checklist) Mission independent
Data source CSM Data Book Vol 1
Data confirmed O.K. F.



Assumptions

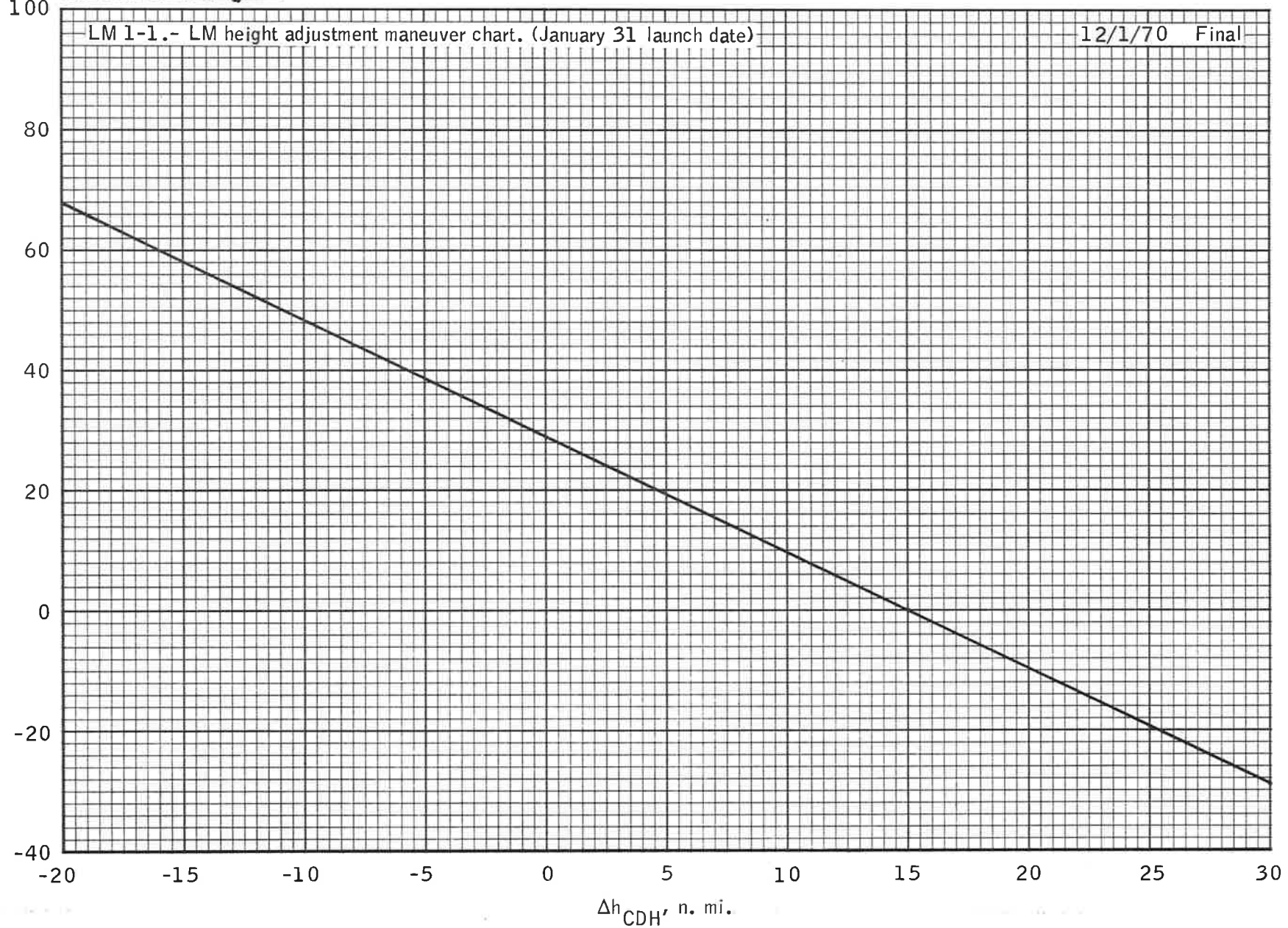
$|\bar{V}_g|$ curve represents minimum SPS burn of 0.5 seconds

CSM weight variations are due to SPS propellant loss only

SPS versus RCS criteria assuming 4-jet ullage (CSM only).

Du ./OMAB/MPAL ..r LM Timeline)
Data source SC O.T.
Data confirmed A.L.D.

Mission pr dependent



LM height maneuver chart.

Moore/OMAB/MPAD (for LM Timeline) Mission profile dependent
Data source Apollo 14 OT
Data confirmed RAM

LM 2-1.- Range and range rate table.
(January 31 launch date) 12/1/70 Final

TIME min:sec	RANGE n. mi.	RANGE RATE fps
INS	146.2	-447.3
1:00	141.7	-444.6
2:00	137.3	-441.3
3:00	133.0	-437.4
4:00	128.7	-433.0
5:00	124.4	-428.0
6:00	120.2	-422.4
7:00	116.0	-416.4
8:00	111.9	-409.9
9:00	107.9	-402.9
10:00	103.9	-395.6

Fridge, ont/OMAB/MPAD r LM Timeline)
Data source SC O.T and I.N. 69-FM-225
Data confirmed C.M.P., A.F.D.

Laun nth dependent
Mission profile dependent

LM 3-1.- PDI abort summary data. (January 31 launch date)

12/1/70 Final

PAGE	ABORT TIME PDI+	INS TIME PDI+	INS N76	INS HA/HINS	BOOST TIME INS+	HAM TIME INS+	CSI TIME INS+	CSI ΔVX	CDH TIME INS+	CDH ΔVX	CDH ΔVZ	TPI TIME PDI+	AIM TIME PDI+	AIM ΔVX	AIM ΔVZ
	PDIO	NA	NA	NA	NA	NA	1+00+00*	49.0	2+02+10*	-120.8	8.9	2+45+46	00+00	101.0	2.7
	NO1+12	NA	NA	NA	1+07+00*	2+07+00*	3+07+00*	37.8	4+09+32*	-128.4	-12.5	4+49+16	12+00	111.4	-50.0
	1+00	2+05	5669.2	145.3/52249.	1+00+00	2+00+00	3+00+00	38.7	4+02+32	-128.5	-25.6	4+49+42	NA	NA	NA
	2+00	3+57	5665.3	144.3/55929.				37.6	4+02+28	-126.7	-23.6				
	3+00	5+41	5659.2	141.8/60020.				36.4	4+02+21	-123.7	-18.1				
	4+00	7+15	5655.4	138.7/60024.				36.3	4+02+12	-119.9	-10.0				
	5+00	8+41	5650.3	134.5/60030.				36.3	4+02+01	-114.8	.8				
	6+00	10+42	5669.8	151.8/62345.	NA	NA	0+55+00	42.4	1+57+42	-132.1	-88.4	2+51+04			
	7+00	12+50	5645.9	137.1/70613.				41.7	1+57+04	-115.5	-64.8				
	8+00	14+40	5619.8	120.0/77315.				41.2	1+56+20	-95.7	-40.5				
	9+00	16+06	5599.2	104.4/78447.				41.8	1+55+39	-76.7	-20.8				
	10+00	17+15	5585.0	91.0/74090.				43.2	1+55+03	-59.9	-6.4				
	11+00	18+19	5576.1	79.0/64618.				45.7	1+54+31	-44.4	4.7				
	12+00	19+27	5558.7	63.7/60261.				46.9	1+53+50	-24.2	16.5				
	13+00	20+27	5543.8	52.8/60258.				46.9	1+53+21	-9.4	23.0				
	14+00	21+26	5528.8	41.8/60255.				46.8	1+52+51	5.7	28.3				
	15+00	22+25	5513.4	30.8/60251.				46.7	1+52+22	21.2	31.7				
	T2-1	7+14†	5512.4	31.5/60154.	50+00	1+50+00	2+40+00	39.5	3+37+31	18.1	11.6	4+49+06			
	NO2+12	NA	NA	NA	1+12+00*	2+12+00*	3+12+00*	36.0	4+15+40	-159.4	-7.9	4+53+04	12+00	142.9	-50.0
	1+00	2+09	5698.3	169.6/52247.	1+00+00	2+00+00	3+00+00	34.7	4+03+30	-153.0	-108.1	4+54+32	NA	NA	NA
	2+00	4+01	5693.9	168.5/56643.				33.6	4+03+26	-151.4	-104.7				
	3+00	5+44	5688.5	166.0/60021.				33.0	4+03+20	-148.9	-96.8				
	4+00	7+18	5684.7	162.8/60025.				33.5	4+03+13	-145.9	-85.9				
	5+00	8+44	5679.6	158.6/60032.				34.2	4+03+03	-141.6	-71.4				
	6+00	10+44	5670.7	152.6/62432.				34.4	4+02+48	-135.3	-53.1				
	7+00	12+53	5654.9	144.6/70907.				33.0	4+02+27	-126.3	-31.7				
	8+00	14+43	5639.3	135.7/77441.				31.9	4+02+04	-116.0	-9.6				
	9+00	16+08	5628.9	128.0/78539.				31.9	4+01+43	-106.5	9.2				
	10+00	17+20	5647.0	140.1/74203.	NA	NA	55+00	40.6	1+57+12	-119.0	-70.4	2+55+53			
	11+00	18+23	5638.8	128.0/64749.				43.7	1+56+41	-105.2	-52.6				
	12+00	19+31	5622.8	112.7/60282.				45.8	1+56+01	-87.0	-32.1				
	13+00	20+30	5608.9	101.8/60279				46.2	1+55+32	-73.7	-19.1				
	14+00	21+30	5594.9	91.0/60276.				46.6	1+55+03	-60.0	-7.4				
	15+00	22+29	5580.6	80.1/60272.				46.8	1+54+34	-46.0	2.7				
	T2-2	7+14†	5512.4	31.5/60154			50+00	49.0	1+47+30	18.4	16.7	2+55+28.6			

† INDICATES TIME IS REFERENCED TO LIFT-OFF.

* INDICATES TIME IS REFERENCED TO PDI.

DuPont/OMAB/MPAD (for LM Timeline)
Data source SC 07.
Data confirmed A.Z.D.

Mission profile dependent

LM 4-1.- Range and range rate data at insertion and 10 minutes prior to subsecuent maneuvers. (January 31 launch date)

12/1/70 Final

PAGE	ABORT TIME PDI+	INS RANGE	INS RANGE RATE	BOOST RANGE	BOOST RANGE RATE	HAM RANGE	HAM RANGE RATE	CSI RANGE	CSI RANGE RATE	CDH RANGE	CDH RANGE RATE
	PDIO	NA	NA	NA	NA	NA	NA	150.2	-533.2	106.8	-176.3
	NO 1+12	NA	NA	380.4	-690.8	151.1	445.0	196.1	-594.6	100.2	-119.9
	01+00	368.0	598.2	372.6	-675.4	137.8	444.6	194.3	-580.6	102.9	-154.2
	02+00	363.8	589.1	367.8	-666.3	137.3	437.9	191.8	-573.6	99.5	-153.9
	03+00	346.4	566.1	348.7	-642.7	130.4	423.7	179.6	-551.5	95.8	-156.6
	04+00	317.0	558.9	320.4	-621.0	116.9	427.7	164.6	-529.5	96.0	-152.3
	05+00	273.1	548.5	278.7	-587.4	97.5	431.5	143.5	-494.7	93.6	-162.5
	06+00	208.1	557.1	NA	NA	NA	NA	228.0	-556.2	101.3	-95.2
	07+00	138.0	513.2					164.3	-459.5	99.8	-101.3
	08+00	70.4	372.8					99.1	-336.6	96.9	-121.5
	09+00	50.9	-226.7					44.0	-146.6	95.4	-126.4
	10+00	88.5	-439.9					27.0	232.6	94.4	-129.4
	11+00	139.3	-462.2					60.6	187.6	91.8	-138.3
	12+00	188.3	-454.9					98.9	91.0	89.6	-143.3
	13+00	238.6	-440.7					137.9	-2.8	88.6	-145.7
	14+00	289.2	-423.9					176.5	-95.4	86.4	-143.8
	15+00	339.8	-405.8					214.3	-188.9	85.6	-149.7
	T2-1	618.6	-382.3	509.0	-193.8	343.3	-360.9	201.3	-202.9	85.5	-110.7
	NO 2+12	NA	NA	565.0	-901.0	272.2	462.5	279.4	-779.3	98.0	-197.7
	01+00	592.0	623.6	591.2	-801.4	245.3	358.5	314.5	-690.2	105.3	-106.4
	02+00	588.2	613.6	586.2	-792.5	245.7	353.2	311.7	-683.9	101.0	-106.4
	03+00	571.4	592.8	566.6	-773.8	239.0	345.9	298.5	-668.6	98.6	-93.6
	04+00	542.7	588.4	537.7	-759.2	223.7	356.2	281.1	-665.7	99.9	-104.9
	05+00	499.6	582.7	495.2	-735.3	202.3	372.1	257.1	-635.5	99.7	-119.4
	06+00	434.9	574.2	432.4	-697.4	171.1	394.4	222.6	-602.1	99.9	-123.3
	07+00	363.5	563.9	363.9	-652.3	141.3	430.7	180.2	-569.2	97.4	-157.9
	08+00	288.3	550.7	292.6	-599.9	102.5	429.0	148.8	-504.6	96.8	-163.4
	09+00	219.2	534.1	227.6	-546.0	72.4	425.3	116.3	-441.6	94.6	-178.2
	10+00	165.5	533.4	NA	NA	NA	NA	189.6	-497.8	97.7	-106.1
	11+00	112.9	485.3					141.4	-418.9	96.0	-120.2
	12+00	69.7	368.4					98.5	-334.5	93.9	-130.5
	13+00	47.3	-44.7					57.4	-215.9	93.3	-129.8
	14+00	70.7	-399.5					26.4	72.7	91.2	-137.4
	15+00	114.5	-459.0					41.5	234.0	90.2	-137.5
	T2-2	319.4	-406.9					202.8	-196.2	89.7	-134.1

Taylor/LAB/MPAD (for LM Timeline)
Data source Apollo 14 OT
Data confirmed BOT

LM 5-1.- Powered descent monitoring chart - PDI thur TD+3 min. (January 31 launch date)

TFI		VI	(-ḦMAX) -HDOT	(HMAX) H	DPS	SBD
0:00	113	5560.0	2.0	50000	95	2/1
0:30	112	5490.0	7.0	49900	95	
1:00	106	5210.0	37.0	49300	91	7/-3
1:30	100	4910.0	59.0	47800	86	
2:00	95	4610.0	73.0	45800	80	15/-11
2:30	90	4310.0	82.0	43500	75	
3:00	86	3990.0	87.0	40900	70	22/-16
3:30	83	3670.0	89.0	38300	65	
4:00	80	3330.0	91.0	(+17000) 35700	60	26/-20
4:30	78	2990.0	91.0	(+17000) 32700	54	
5:00	77	2640.0	93.0	(+15800) 30500	49	29/-22
5:30	74	2270.0	92.0	(+12800) 26400	44	
6:00	73	1890.0	86.0	(+11400) 24700	39	32/-25
6:30	70	1490.0	(432.0) 69.0	(+9200) 21800	33	
7:00	66	1230.0	(401.0) 95.0	(+8200) 18900	30	39/-29
7:30	65	980.0	(367.0 119.0	(+6900) 16100	27	
8:00	65	730.0	(323.0) 139.0	(+5600) 12800	23	40/-29
8:30	59	480.0	(252.0) 154.0	(+2400) 8300	20	

Launch month dependent
Mission profile dependent

12/1/70 Final

H	(-ḦMAX) -HDOT	DPS	VH
7000	(228.0) 151.0	19	407.0
6000	(208.0) 134.0	19	382.0
5000	(187.0) 113.0	18	350.0
4000	(163.0) 93.0	17	311.0
3000	(136.3) 71.0	16	264.0
2000	(105.0) 48.0	15	200.0
1000	(64.0) 27.0	13	118.0
500	(36.0) 17.0	11	63.0
400	(29.0) 14.0	11	47.0
300	(21.0) 12.0	11	36.0
200	(12.0) 9.0	10	22.0

Lamey/LAB/MPAD (for LM Timeline) Launch month dependent
Data source H-3 O.T. (Jan 31, 1970) Mission profile dependent
Data confirmed WCL

LM 6-1.- Ascent monitoring chart.
(January 31 launch date) 12/1/70 Final

Pitch deg	OHW no yaw deg	TFI min:sec	VI fps	H dot fps	H ft	SBD pitch/yaw* deg
		0:00	15.1	0	0	119.7/-37.7
		0:10	55.7	54.2	270	
307.7	39.23	0:30	169.2	93.0	1862	
304.9	37.56	1:00	435.0	126.6	5170	147.5/13.6
301.7	35.45	1:30	725.8	153.2	9385	
298.5	33.32	2:00	1036.0	172.7	14290	151.6/18.6
295.3	31.12	2:30	1365.4	185.4	19679	
291.9	28.86	3:00	1714.4	191.6	25350	156.1/23.7
288.4	26.51	3:30	2083.8	191.5	31111	
284.8	24.08	4:00	2474.5	185.3	36778	161.3/29.1
281.0	21.51	4:30	2887.4	173.4	42172	
277.0	18.84	5:00	3323.7	156.0	47125	167.7/34.8
272.8	16.05	5:30	3784.8	133.5	51479	
268.5	13.19	6:00	4272.9	106.6	55089	175.6/40.5
264.1	10.34	6:30	4789.4	77.2	57850	
259.2	7.12	7:00	5337.1	45.1	59692	185.7/46.1
257.1	5.61	7:10.7	5540.6	32.2	60107	188.3/47.3

*Assumes 30° pilot yaw maneuver completed at 1 minute.

Moore/OMAB/MPAD (for LM Timeline)
Data source Apollo 14 or
Data confirmed RAM

Launch day dependent
Launch month dependent
Mission profile dependent

LM 7-1.- Lift-off table. 12/1/70 Final
(January 31 launch date)

REV	NEW TIG	NOM TIG
15		110:53:43
16		112:52:04
17		114:50:22
18		116:48:40
19		118:47:15
20		120:45:33
21		122:43:51
22		124:42:09
23		126:40:27
24		128:38:45
25		130:37:03
26		132:35:21
27		134:33:39
28		136:31:57
29		138:30:17
30		140:28:33
32		144:22:47

Blucker/MPB/MPAD (for LM G and N Dictionary)
Data source JPL Ephemeris
Data confirmed 11/14/70

Launch day dependent
Launch month dependent

LM 8-1.- Planet unit vectors (lunar referenced)
Venus, Mars, Jupiter, Saturn.

12/1/70 Final
Revision 1

0 HR GET = 1:31:20:20 GMT
LO = 1:31:__:__

VENUS UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	-.01107	-.93644	-.35065
102.0	-.00954	-.93643	-.35074
104.0	-.00801	-.93641	-.35082
106.0	-.00647	-.93639	-.35091
108.0	-.00494	-.93636	-.35100
110.0	-.00341	-.93634	-.35108
112.0	-.00187	-.93631	-.35117
114.0	-.00034	-.93628	-.35125
116.0	.00120	-.93625	-.35134
118.0	.00273	-.93621	-.35142
120.0	.00427	-.93618	-.35150
122.0	.00581	-.93614	-.35158
124.0	.00734	-.93610	-.35166
126.0	.00888	-.93605	-.35174
128.0	.01042	-.93601	-.35182
130.0	.01196	-.93596	-.35190
132.0	.01350	-.93591	-.35198
134.0	.01503	-.93586	-.35206
136.0	.01657	-.93580	-.35213
138.0	.01812	-.93575	-.35221
140.0	.01966	-.93569	-.35229
142.0	.02120	-.93562	-.35236
144.0	.02274	-.93556	-.35243
146.0	.02428	-.93549	-.35251
148.0	.02583	-.93543	-.35258
150.0	.02737	-.93535	-.35265

MARS UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	-.37282	-.85471	-.36121
105.0	-.37078	-.85544	-.36158
110.0	-.36873	-.85617	-.36195
115.0	-.36667	-.85690	-.36231
120.0	-.36462	-.85762	-.36267
125.0	-.36257	-.85834	-.36304
130.0	-.36051	-.85906	-.36340
135.0	-.35845	-.85977	-.36376
140.0	-.35638	-.86047	-.36412
145.0	-.35432	-.86117	-.36447
150.0	-.35225	-.86187	-.36483

JUPITER UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	-.44978	-.82567	-.34054
125.0	-.44779	-.82659	-.34092
150.0	-.44583	-.82750	-.34130

SATURN UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	.69388	.67495	.25094
150.0	.69286	.67580	.25149

Blucker/MPB/MPAD (for LM G and Dictionary)
Data source. TLI Ephem
Data confirmed 12/2/70

Launch day dependent
Launch month dependent
Mission profile dependent

LM 8-2.- Earth unit vectors

12/1/70 Final
Revision 2

EARTH VECTORS

0 HR GET = 1:31:20:20 GMT LO = 1:31: :

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.00	-.25395	-.84966	-.46217
100.50	-.24941	-.85082	-.46250
101.00	-.24487	-.85197	-.46282
101.50	-.24033	-.85309	-.46313
102.00	-.23578	-.85420	-.46343
102.50	-.23123	-.85528	-.46372
103.00	-.22667	-.85635	-.46400
103.50	-.22212	-.85740	-.46427
104.00	-.21756	-.85843	-.46453
104.50	-.21299	-.85994	-.46478
105.00	-.20843	-.86043	-.46501
105.50	-.20386	-.86140	-.46524
106.00	-.19929	-.86235	-.46546
106.50	-.19471	-.86328	-.46567
107.00	-.19014	-.86420	-.46586
107.50	-.18556	-.86509	-.46605
108.00	-.18098	-.86597	-.46622
108.50	-.17639	-.86682	-.46639
109.00	-.17181	-.86766	-.46655
109.50	-.16722	-.86848	-.46669
110.00	-.16263	-.86927	-.46683
110.50	-.15804	-.87005	-.46695
111.00	-.15345	-.87081	-.46707
111.50	-.14886	-.87155	-.46717
112.00	-.14426	-.87227	-.46727
112.50	-.13967	-.87298	-.46735
113.00	-.13507	-.87366	-.46743
113.50	-.13047	-.87432	-.46749
114.00	-.12587	-.87497	-.46755
114.50	-.12127	-.87560	-.46759
115.00	-.11667	-.87620	-.46762
115.50	-.11206	-.87679	-.46765
116.00	-.10746	-.87736	-.46766
116.50	-.10285	-.87791	-.46767
117.00	-.09825	-.87844	-.46766
117.50	-.09365	-.87895	-.46764
118.00	-.08904	-.87944	-.46762
118.50	-.08443	-.87992	-.46758
119.00	-.07983	-.88037	-.46753
119.50	-.07522	-.88081	-.46748
120.00	-.07062	-.88122	-.46741
120.50	-.06601	-.88162	-.46733
121.00	-.06141	-.88200	-.46725
121.50	-.05680	-.88236	-.46715
122.00	-.05220	-.88270	-.46705
122.50	-.04759	-.88302	-.46693
123.00	-.04299	-.88332	-.46680
123.50	-.03839	-.88361	-.46667
124.00	-.03379	-.88387	-.46652
124.50	-.02919	-.88412	-.46637
125.00	-.02459	-.88435	-.46620
125.50	-.01999	-.88455	-.46603
126.00	-.01539	-.88474	-.46584
126.50	-.01079	-.88491	-.46564
127.00	-.00620	-.88507	-.46544
127.50	-.00161	-.88520	-.46523
128.00	.00300	-.88531	-.46500
128.50	.00759	-.88541	-.46477
129.00	.01217	-.88549	-.46452
129.50	.01676	-.88554	-.46427
130.00	.02135	-.88558	-.46401
130.50	.02593	-.88560	-.46373
131.00	.03051	-.88561	-.46345
131.50	.03509	-.88559	-.46316
132.00	.03966	-.88555	-.46286
132.50	.04424	-.88550	-.46254
133.00	.04881	-.88543	-.46222
133.50	.05338	-.88534	-.46189
134.00	.05794	-.88523	-.46155
134.50	.06251	-.88510	-.46120
135.00	.06707	-.88495	-.46084
135.50	.07162	-.88479	-.46047
136.00	.07618	-.88460	-.46009
136.50	.08073	-.88440	-.45970
137.00	.08528	-.88418	-.45931
137.50	.08982	-.88394	-.45890
138.00	.09436	-.88369	-.45848
138.50	.09890	-.88341	-.45806
139.00	.10344	-.88312	-.45762
139.50	.10797	-.88281	-.45718
140.00	.11249	-.88248	-.45672
140.50	.11702	-.88213	-.45626
141.00	.12154	-.88176	-.45579
141.50	.12605	-.88138	-.45530
142.00	.13056	-.88097	-.45481
142.50	.13507	-.88055	-.45431
143.00	.13958	-.88011	-.45380
143.50	.14407	-.87966	-.45328
144.00	.14857	-.87918	-.45275
144.50	.15306	-.87869	-.45221
145.00	.15754	-.87817	-.45167
145.50	.16202	-.87765	-.45111
146.00	.16650	-.87710	-.45055
146.50	.17097	-.87653	-.44997
147.00	.17544	-.87595	-.44939
147.50	.17990	-.87535	-.44880
148.00	.18436	-.87473	-.44819
148.50	.18881	-.87409	-.44758
149.00	.19325	-.87344	-.44696
149.50	.19769	-.87277	-.44633
150.00	.20213	-.87207	-.44570

Lanier/MPB/MPAD (for Star Charts)
Data source US Naval Observatory
Data confirmed RRS

Nearst mean Besselian year

LM 8-3.- Star unit vectors. (January 31 launch date)

12/1/70 Final

DATA VALID FROM 1 JULY 70 TO 30 JUNE 71

STAR NO. (OCTAL)	UNIT VECTORS X (R1)	Y (R2)	Z (R3)	ECLIPTIC COORDINATES LONGITUDE (DEG.)	LATITUDE (DEG.)	STAR IDENTIFICATION COMMON NAME	GREEK IDENTIFIER AND CONSTELLATION
046	.78393	.47820	.39596	37.3	10.0	HAMAL	ALPHA ARIETIS
047	.58795	.64636	-.48634	34.2	-44.7		ALPHA FORNACIS
050	-.38513	.79364	.47097	112.8	6.7	POLLUX	BETA GEMINORUM
051	-.25997	.23226	-.93727	211.6	-72.2	MIAPLACIDUS	BETA CARINAE
052	-.45587	.11800	.88219	134.8	49.7	DUBHE	ALPHA URSAE MAJORIS
053	-.64872	-.11412	-.75242	211.9	-40.2		GAMMA CENTAURI
054	-.37794	-.31049	-.87221	239.1	-42.6	RIGIL KENT	ALPHA CENTAURI
055	.02768	.99128	.12885	88.3	-16.0	BETELGEUSE	ALPHA ORIONIS
056	-.42803	-.25153	-.86806	233.4	-44.1	HADAR	BETA CENTAURI
057	.15730	.98139	.11016	80.5	-16.8	BELLATRIX	GAMMA ORIONIS
060	.13564	.86757	.47845	82.2	5.4	EL NATH	BETA TAURI
061	.10996	.99371	-.02128	83.1	-24.5	ALNI LAM	EPSILON ORIONIS
062	.09017	.99534	-.03414	84.3	-25.3	ALNITAK	ZETA ORIONIS
063	-.08880	.94722	-.30803	96.8	-41.3	MURZIM	BETA CANIS MAJORIS
064	-.15020	.94736	.28276	98.7	-6.7	ALHENA	GAMMA GEMINORUM
065	-.21723	.84781	-.48377	110.4	-51.4	ADHERA	EPSILON CANIS MAJORIS
066	-.25905	.85787	-.44379	113.0	-48.5	AL WAZOR	DELTA CANIS MAJORIS
067	-.33408	.77994	.52922	109.8	10.1	CASTOR	ALPHA GEMINORUM
070	-.29532	.41433	-.86088	172.7	-72.7	AVIOR	EPSILON CARINAE
071	-.37984	.43733	-.81514	168.5	-67.2		DELTA VELORUM
072	-.54083	-.07011	-.83821	216.3	-47.8	GACRUX	GAMMA CRUCIS
073	-.49689	-.10112	-.86190	221.2	-48.6	BECRUX	BETA CRUCIS
074	-.54279	-.12721	.83018	158.5	54.3	ALIOTH	EPSILON URSAE MAJORIS
075	-.09848	-.79165	-.60299	264.2	-13.8	SHAULA	LAMBDA SCORPII
076	-.07891	-.72731	-.68176	265.2	-19.6		THETA SCORPII
077	.07997	-.82123	-.56497	274.7	-11.0	KAUS AUST	EPSILON SAGITTARII
100	.51490	.01713	.85708	34.7	51.2	CAPH	BETA CASSIOPEIAE
101	.73337	.07984	-.67512	345.1	-40.6	ANKAA	ALPHA PHOENICIS
102	.77875	.23847	.58024	30.0	25.9	MIRACH	BETA ANDROMEDAE
103	.63821	.37634	.67161	43.8	27.8	ALMACH	GAMMA-PRIME ANDROMEDAE
104	.12826	.99172	-.00558	82.0	-23.6	MINTAKA	DELTA ORIONIS
105	.05855	.98403	-.16813	86.0	-33.1	SAIPH	KAPPA ORIONIS
106	.00802	.70772	.70644	89.5	21.5	MENKALINAN	BETA AURIGAE
107	-.30894	.81601	-.48855	119.1	-50.6	ALUDRA	ETA CANIS MAJORIS
110	-.39088	.65985	-.64173	138.2	-58.4		ZETA PUPPIS
111	-.52980	.49870	-.68601	160.8	-55.9	SUHAIL	LAMBDA VELORUM
112	-.38743	.33586	-.85854	184.9	-67.1		IOTA CARINAE
113	-.53266	.14247	.83425	139.0	45.1	MERAK	BETA URSAE MAJORIS
114	-.53556	-.20227	.81992	165.3	56.4	MIZAR	ZETA URSAE MAJORIS
115	-.19921	-.18378	.96257	132.9	73.0	KOCHAB	BETA URSAE MINORIS
116	-.01105	-.62253	.78252	267.6	74.9	ELTANIN	GAMMA DRACONIS
117	.44157	-.62373	.64497	324.4	57.1	SADR	GAMMA CYGNI
120	.59879	-.32372	-.73257	315.5	-32.9	AL NA'IR	ALPHA GRUIS
121	.64138	-.23046	-.73179	321.9	-35.4		BETA GRUIS
122	.54577	.09341	.83271	37.4	46.6	SCHEDAR	ALPHA CASSIOPEIAE
123	-.58949	.01978	.80754	150.1	47.1	PHECDA	GAMMA URSAE MAJORIS
124	-.46663	-.79706	-.38334	242.2	-2.0		DELTA SCORPII
125	-.25449	-.78652	-.56269	254.9	-11.7		EPSILON SCORPII
126	.96456	.04945	.25920	8.8	12.6		GAMMA PEGASI
127	-.06610	-.77414	-.62955	266.1	-15.6		KAPPA SCORPII
130	.46566	.17853	.86677	47.5	46.4		DELTA CASSIOPEIAE
131	.82414	.44298	.35294	33.6	8.5		BETA ARIETIS
132	.50496	.76116	.40700	59.6	4.0		ETA TAURI
133	.44942	.72136	.52694	62.7	11.3		ZETA PERSEI
134	.39524	.65715	.64182	65.3	19.1		EPSILON PERSEI
135	.23400	.80416	.54642	76.2	10.5		IOTA AURIGAE
136	.23072	.96891	-.08929	74.9	-27.9		BETA ERIDANI
137	.13415	.92526	-.35481	79.3	-43.9		BETA LEPORIS

LM 8-3.- Concluded.

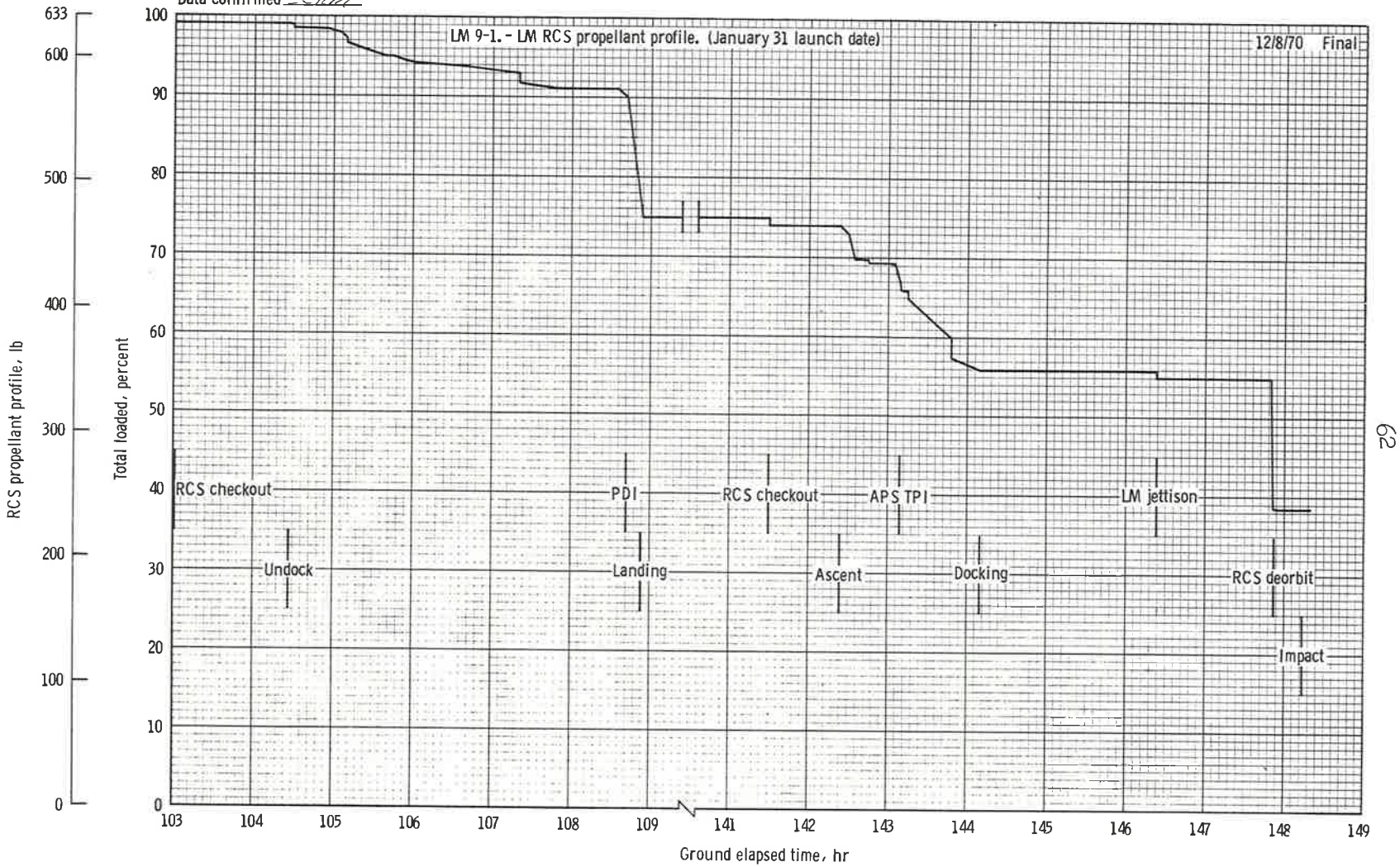
12/1/70 Final

DATA VALID FROM 1 JULY 70 TO 30 JUNE 71

STAR NO. (OCTAL)	UNIT VECTORS X (R1)	Y (R2)	Z (R3)	ECLIPTIC COORDINATES LONGITUDE (DEG.)	LATITUDE (DEG.)	STAR IDENTIFICATION COMMON NAME	GREEK IDENTIFIER AND CONSTELLATION
140	.11828	.94453	-.30639	81.0	-41.1		ALPHA LEPORIS
141	.11254	.98827	-.10327	82.6	-29.2		IOTA ORIONIS
142	.09787	.92764	.36043	84.4	-2.2		ZETA TAURI
143	.07722	.82456	-.56047	81.8	-57.4		ALPHA COLUMBAE
144	.00784	.79636	.60477	89.5	13.8		THETA AURIGAE
145	-.13532	.62042	-.77251	117.3	-72.9		TAU PUPPIS
146	-.26025	.75455	-.60243	119.9	-58.5		PI PUPPIS
147	-.47755	.77695	-.41024	131.0	-43.3		RHO PUPPIS
150	-.44258	.36739	-.81801	178.5	-63.7		KAPPA VELORUM
151	-.84888	.40318	.34184	149.2	8.8		GAMMA-PRIME LEONIS
152	-.61838	.20836	-.75775	190.1	-51.1		MU VELORUM
153	-.91559	.19224	.35319	160.9	14.3		DELTA LEONIS
154	-.90945	-.13130	-.39453	197.0	-18.0		BETA CORVI
155	-.35448	-.05525	-.93343	230.0	-56.6		ALPHA MUSCAE
156	-.98441	-.17441	-.02252	189.7	2.8		GAMMA VIRGINIS
157	-.76071	-.18500	.62217	174.2	40.1		ALPHA-SQUARED CANES VENATICI
160	-.94699	-.25699	.19277	189.5	16.2		EPSILON VIRGINIS
161	-.75603	-.27129	-.59566	212.7	-26.0		IOTA CENTAURI
162	-.54352	-.24781	-.80198	225.2	-39.6		EPSILON CENTAURI
163	-.83457	-.44985	.31800	198.9	28.1		ETA BOOTIS
164	-.61955	-.47932	.62162	197.3	49.6		GAMMA BOOTIS
165	-.58200	-.46152	-.66954	229.8	-25.5		ETA CENTAURI
166	-.51986	-.43618	-.73450	233.1	-30.0		ALPHA LUPORIS
167	-.67199	-.58271	.45703	207.7	40.6		EPSILON BOOTIS
170	-.71106	-.64741	-.27433	224.7	.3	ZUBEN'UBI	ALPHA-SQUARED LIBRAE
171	-.52455	-.50932	-.68223	234.6	-25.0		BETA LUPI
172	-.64929	-.74326	-.16121	229.0	8.5		BETA LIBRAE
173	-.45055	-.60446	-.65699	241.1	-21.2		GAMMA LUPI
174	-.55975	-.82085	.11347	231.7	25.5		ALPHA SERPENTIS
175	-.45911	-.77241	-.43887	242.5	-5.5		PI SCORPII
176	-.45727	-.82278	-.33755	242.8	1.0		BETA-PRIME SCORPII
177	-.19435	-.43445	.87948	194.1	78.4		ETA DRACONIS
200	-.35978	-.85768	.36734	240.7	42.7		BETA HERCULIS
201	-.32286	-.82041	-.47190	251.1	-6.1		TAU SCORPII
202	-.35412	-.91724	-.18240	248.8	11.4		ZETA OPHIUCHI
203	-.29047	-.80014	.52479	241.1	53.1		ZETA HERCULIS
204	-.21365	-.93873	-.27044	257.6	7.2	SABIK	ETA OPHIUCHI
205	-.09132	-.55893	-.82417	263.8	-32.3		BETA ARAE
206	-.10803	-.78838	-.60563	263.6	-14.0		NU SCORPII
207	-.08528	-.63906	-.76442	264.5	-26.6		ALPHA ARAE
210	-.08038	-.60591	.79146	251.6	75.3		BETA DRACONIS
211	-.07804	-.99375	.07982	264.9	27.9		BETA OPHIUCHI
212	.07234	-.86438	-.49761	274.2	-6.5		DELTA SAGITTARII
213	.10293	-.89715	-.42956	275.9	-2.1		LAMBDA SAGITTARII
214	.22712	-.83641	-.49884	283.2	-7.2		ZETA SAGITTARII
215	.30984	-.63480	.70784	315.8	64.4		DELTA CYGNI
216	.43436	-.88196	.18295	300.5	31.2		GAMMA AQUILAE
217	.54762	-.62424	.55718	327.3	49.4		EPSILON CYGNI
220	.35141	-.30044	.88671	12.4	68.9		ALPHA CEPHI
221	.79924	-.53181	-.27999	323.1	-2.6		DELTA CAPRICORNI
222	.44438	-.21547	-.86954	309.3	-45.4		ALPHA TUCANAE
223	.85577	-.21986	.46832	359.0	31.1		BETA PEGASI
224	.93631	-.23643	.25964	353.1	19.4	MARKAB	ALPHA PEGASI
225	.41263	.23311	-.88056	341.7	-64.2		ALPHA HYDRI
226	.82321	.56514	-.05423	31.1	-15.9		OMICRON CETI
227	.52007	.54935	.65402	55.8	22.4		BETA PERSEI
230	-.43367	.33175	-.83778	183.8	-64.2		N VELORUM
231	-.40959	.14521	-.90064	208.8	-62.1		THETA CARINAE
232	-.63497	-.01897	-.77230	207.1	-44.5		DELTA CENTAURI
233	-.23680	-.38106	-.89371	251.4	-41.9		BETA TRIANGULI AUSTRALIS
234	.26797	-.93335	.23886	289.4	36.2		ZETA AQUILAE
235	.27297	-.89231	-.35953	285.8	1.4		PI SAGITTARII
236	-.44989	-.89085	-.06316	241.9	17.2		DELTA OPHIUCHI

Mayfield/GPB/MPAD (for LM Systems)
Data source SODB, POST FLIGHT
Data confirmed ~~1969~~

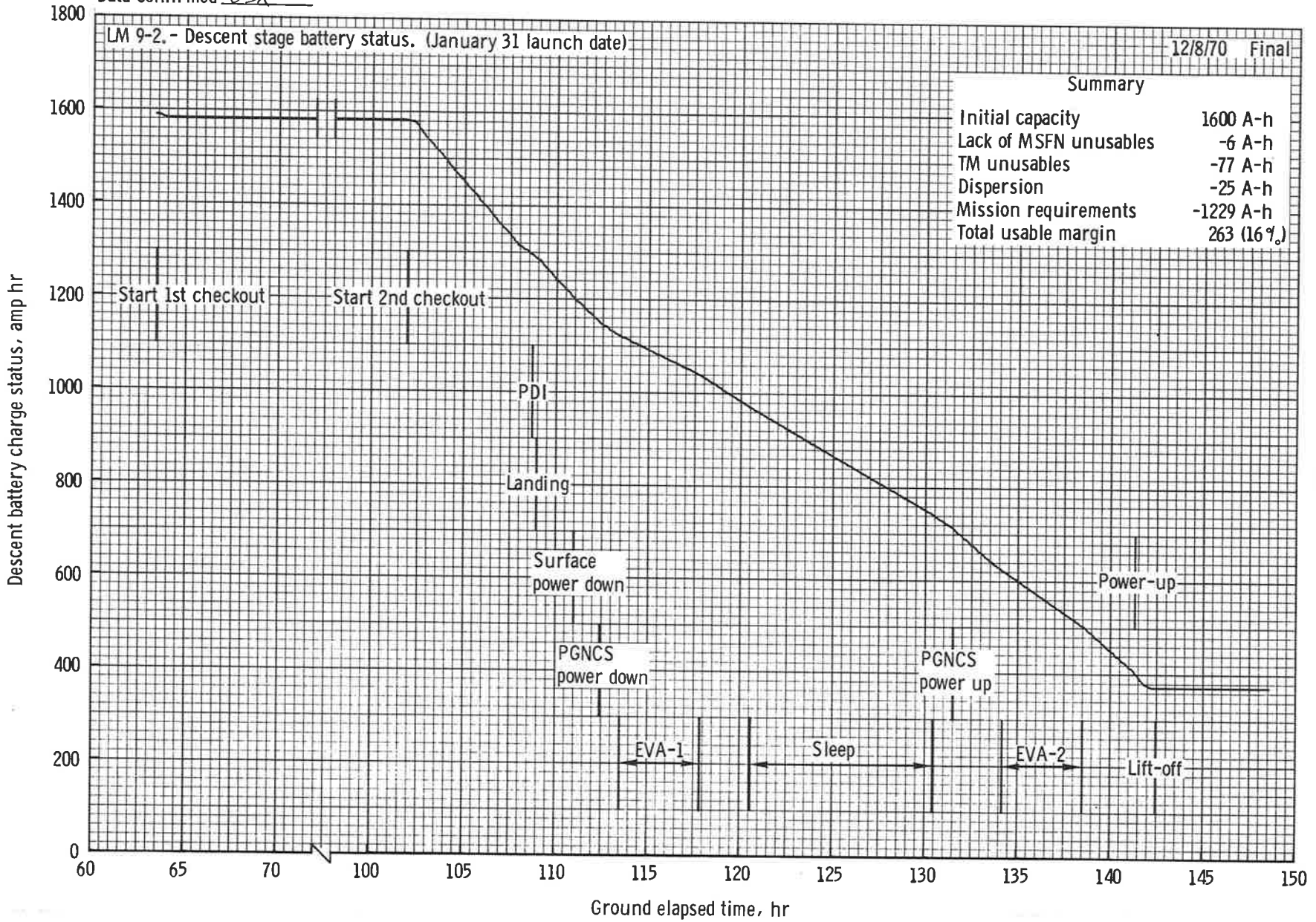
Mission profile dependent



LM RCS propellant profile.

Kitchey/GPB/MPAD (for LM Systems)
Data source Flight Plan
Data confirmed USR

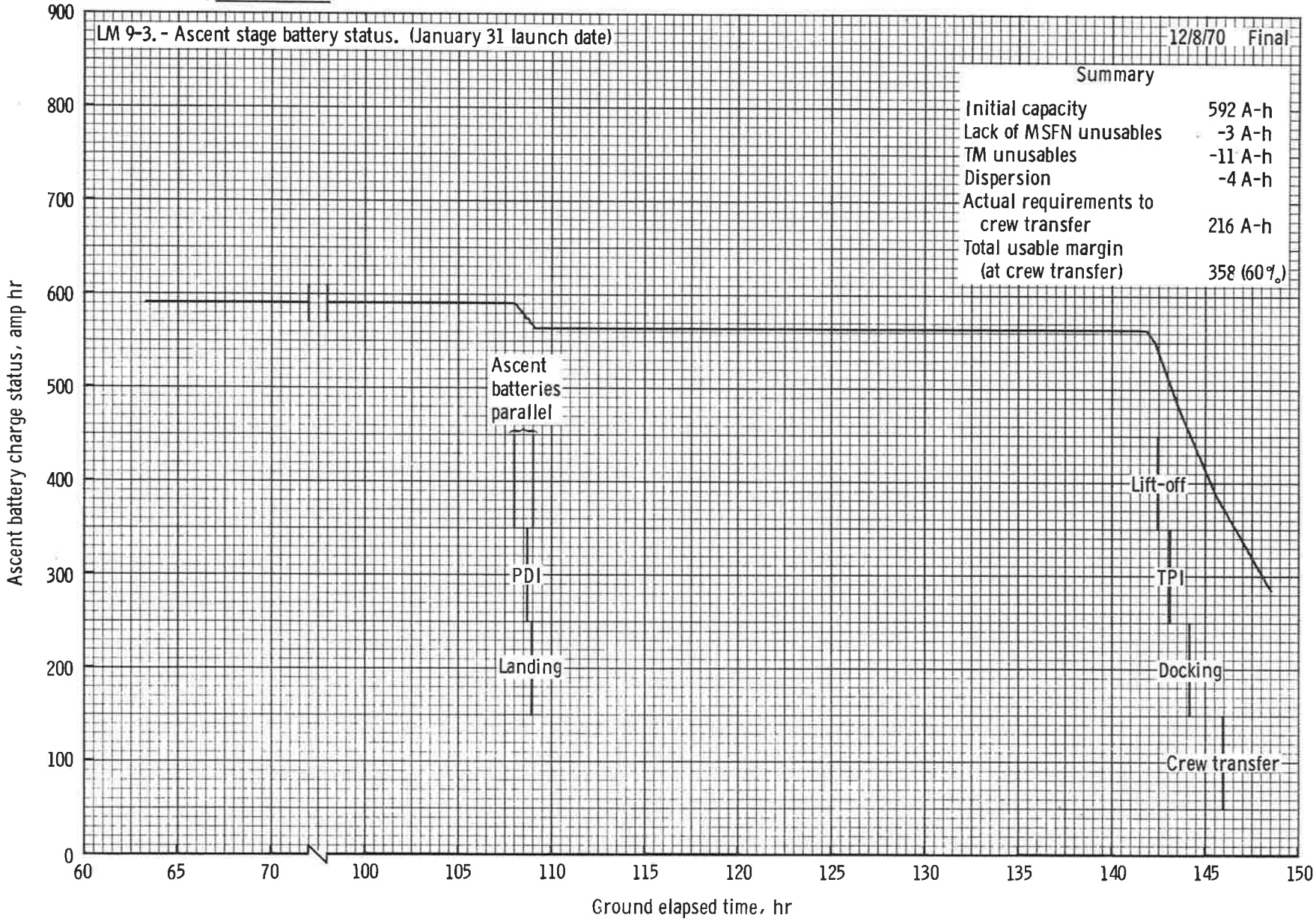
Mission profile dependent



LM-8 descent stage amp hours remaining.

Ritchey/GPB/MPAD (for LM Systems)
Data source Flight Plan
Data confirmed USR

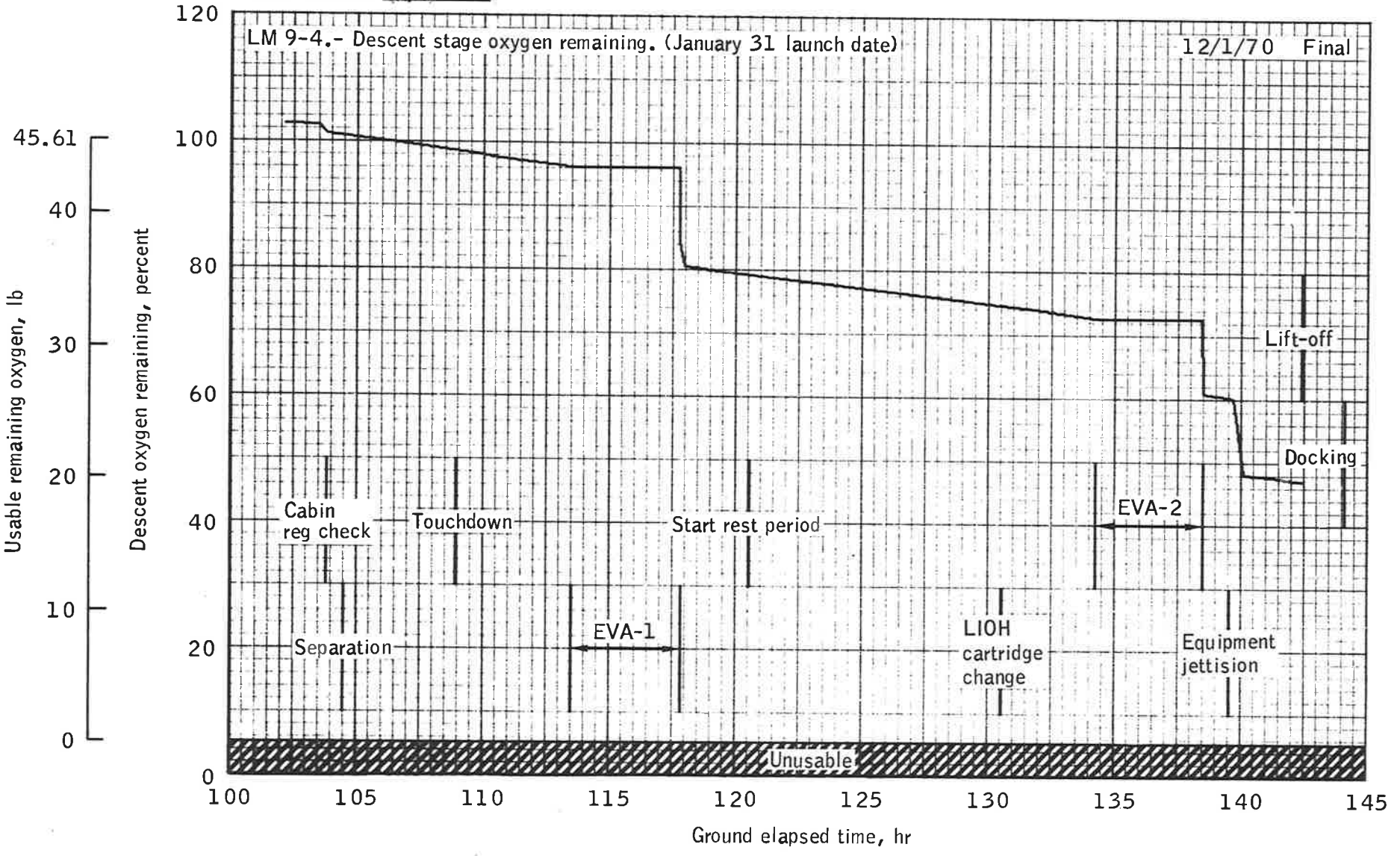
Mission profile dependent



LM-8 ascent stage amp hours remaining.

Swalin/GPB/MPAD (for LM Systems)
Data source [illegible]
Data confirmed [illegible]

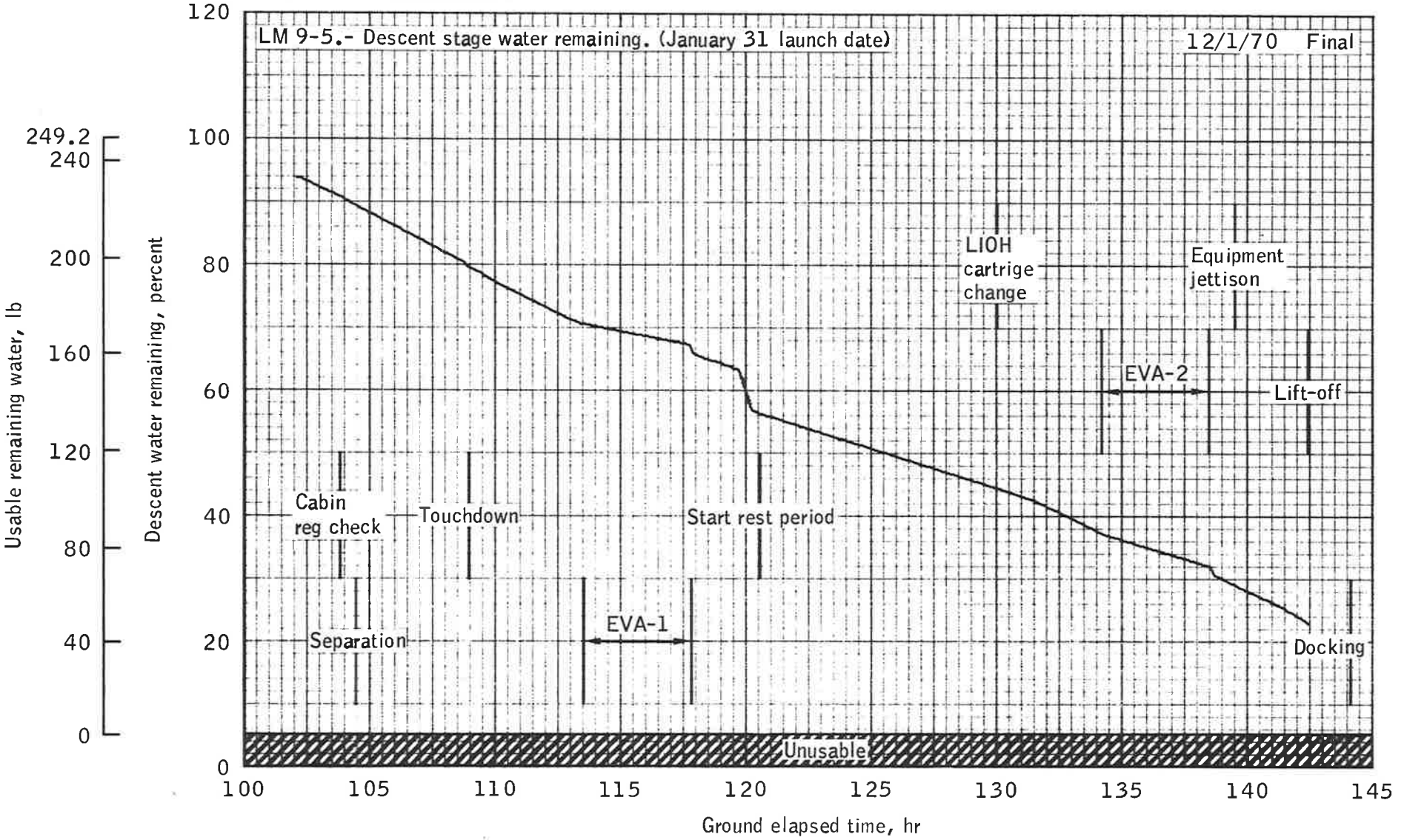
Mission profile dependent



Descent oxygen remaining.

Swalin/GPB/MPAD (for LM Systems)
Data source FLIGHT PLAN
Data confirmed Bell

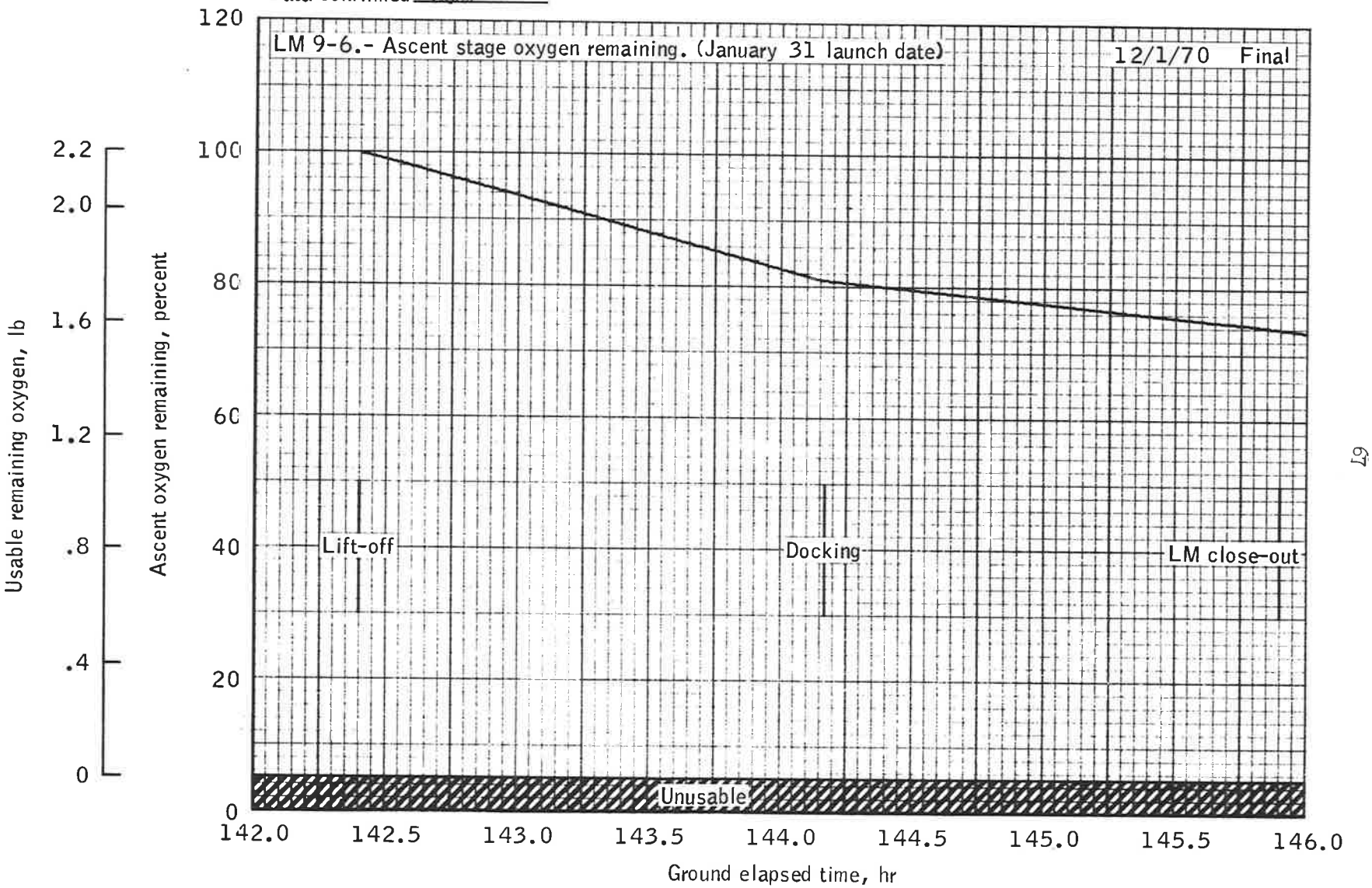
Mission profile dependent



Descent water remaining.

Swalin/GPB/MPAD (for LM Systems)
Data source FLIGHT PLAN
Data confirmed GAC

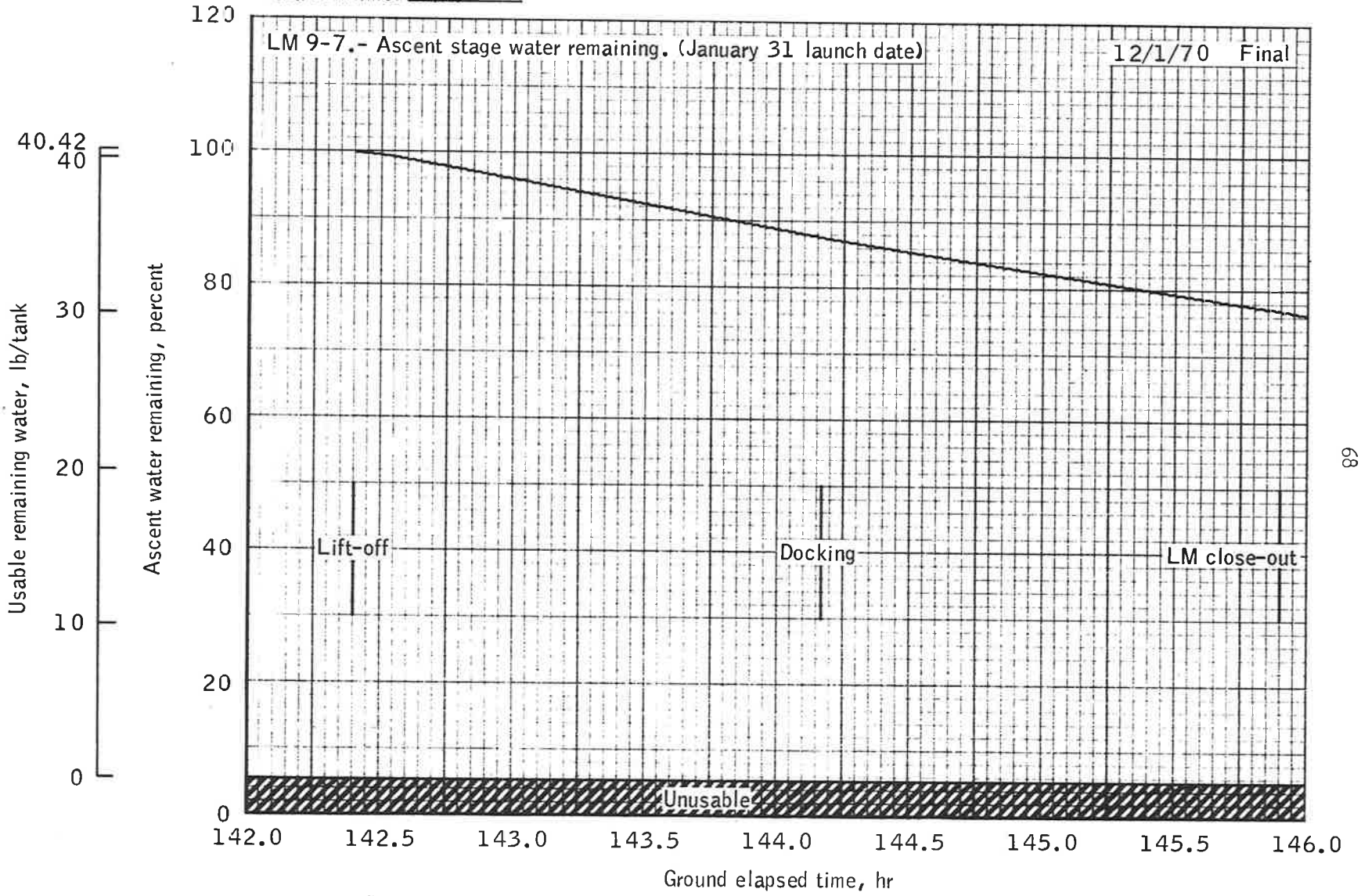
Mission profile dependent



Ascent tank 1 oxygen remaining.

Swalin/GPB/MPAD (for LM Systems)
Data source Flight Plan
Data confirmed Swalin

Mission profile dependent



Ascent water remaining.

Ritchey/GPB/MPAD (for LM Systems)
Data source Flight Plan
Data confirmed CSR

LM 9-8.- Ground rules and assumptions for the LM EPS analysis. (January 31 launch date) 12/8/70 Final

Ground Rules and Assumptions for the LM EPS Analysis

1. Energy available from the descent batteries is 1600 A-h and from the ascent batteries is 592 A-h.

2. Energy unusables caused by lack of continuous MSFN coverage for the descent and ascent stages are 6 and 3 A-h, respectively.

3. Energy unusables caused by TM inaccuracies for the descent and ascent stages were 77 and 11 A-h, respectively.

4. Energy unusables caused by checklist deviations (dispersion) for the descent and ascent stages were 25 and 4 A-h, respectively. This dispersion is obtained by calculating 2 percent of the energy used.

5. In accordance with the flight plan, the PGNCS was in standby mode from 1.3 hours following surface powerdown until 9.75 hours before powerup.

6. The RCS heaters were assumed to have a 100 percent duty cycle for 15 minutes after initial activation and then to decrease to a 7 percent duty cycle until undocking. From undocking until lunar landing plus 2 hours, the heaters were assumed to cycle at 0 percent, but, from landing plus 2 hours until lunar lift-off, the duty cycle was assumed to be 4.5 percent.

7. At the beginning of the analysis, it was assumed that a total of 10 A-h had been used from the descent batteries between 30 minutes before launch and the conclusion of transposition and docking.

8. The CDR and LMP forward window heaters were assumed not to be needed.

9. All floodlights were turned off at the beginning of EVA-1 and on again at powerup.

10. No duty cycle was assigned to the portable utility lights.

11. The liquid cooled garment pump was cycled as dictated by the time line.

12. The short (M=1) rendezvous was considered nominal.

13. The TV camera was assumed to be on from the beginning of EVA-1 until surface powerup.

Scheffman/LMAB/MPAD (for LM Cue Cards)
Data source
Data confirmed MSC

Launch day dependent
Launch month dependent
Mission profile dependent

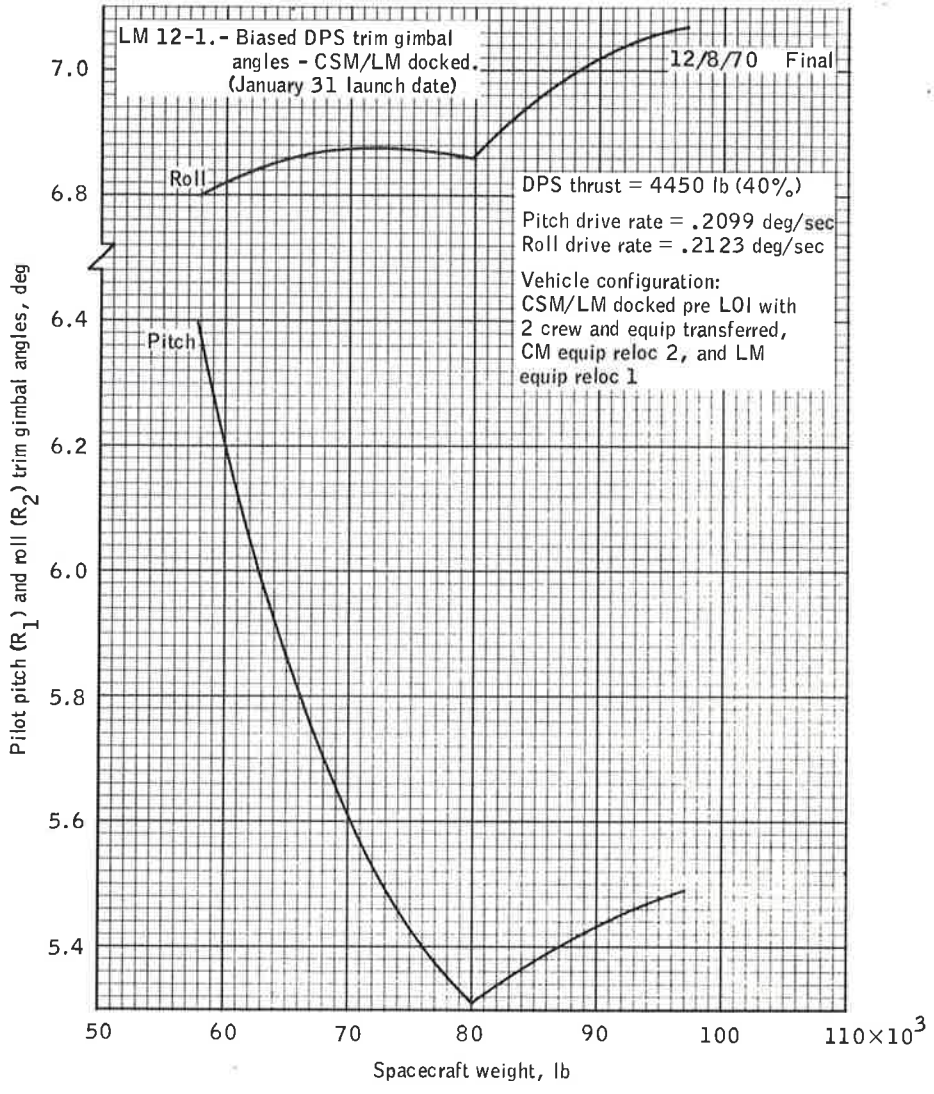
LM 11-1 S-band antenna angles. 12/1/70
Final
Revision 2

S-BAND
ANTENNA ANGLES
DESCENT REFSMMAT

YAW=0° ANTENNA		IGA (PITCH)	YAW=180° ANTENNA	
P	Y		P	Y
121	-38	0	57	-43
108	-41	10	70	-46
95	-42	20	84	-48
82	-42	30	99	-47
69	-40	40	113	-45
57	-37	50	126	-42
46	-32	60	138	-37
36	-27	70	148	-32
27	-21	80	157	-25
19	-15	90	165	-19
12	-8	100	172	-12
5	-1	110	179	-5
-2	6	120	186	2
-10	13	130	194	9
-17	20	140	201	16
-25	27	150	209	23
-35	33	160	218	28
-45	38	170	228	34
-57	43	180	239	38
-70	46	190	252	41
276	48	200	265	42
261	47	210	278	42
247	45	220	-69	40
234	42	230	-57	37
222	37	240	-46	32
212	32	250	-36	27
203	25	260	-27	21
195	19	270	-19	15
188	12	280	-12	8
181	5	290	-5	1
174	-2	300	2	-6
167	-9	310	10	-13
159	-16	320	17	-20
151	-23	330	25	-27
142	-28	340	35	-33
132	-34	350	45	-38

Hischke/MPSO/MPAD (LM Contingency)
Data source SODB Vol. III A-81
Data confirmed 12/7/70 K.H.

Mission profile dependent



Biased DPS trim gimbal angles - CSM/LM docked.

Payne/LAB/MPAD (for LM Cue Cards) Mission profile dependent
Data source TRW
Data confirmed DOF

LM 13-1.-
LPD 12/1/70
changes.. Final

LPD CHANGES			
ALT	UP	DN	X
6	725	775	800
5	650	700	675
4	550	575	550
3	425	450	400
2	275	300	275
1	100	115	125
0.5	35	40	50

Bolt/LAB/MPAD
Data source LAB Analysis
Data confirmed GAB

Mission profile dependent

LM 14-1.- FDAI and overhead window angles for manual descent abort. (January 31 launch date)

12/8/70 Final Revision 1

TIME OF ABORT	DPS/APS				APS			
	FDAI		OVERHEAD WINDOW		FDAI		OVERHEAD WINDOW	
PDI+ (→LV)	ABORT + 0:20 (→300°)		ABORT + 0:20 (→37°)		ABORT + 0:20 (→300°)		ABORT + 0:20 (→37°)	
	T_1 (→270°)	T_2 (SHUTDOWN)	T_1 ($\rightarrow\alpha_2$)	T_2 (SHUTDOWN)	T_1 (→270°)	T_2 (SHUTDOWN)	T_1 ($\rightarrow\alpha_2$)	T_2 (SHUTDOWN)
0:30	NA	2:00	NA	2:00	NA	1:55	NA	2:00
1:00	NA	2:40	NA	2:40	NA	2:35	NA	2:40
1:30	NA	3:20	NA	3:25	NA	3:15	NA	3:25
2:00	2:40	4:15	2:40(0°)	4:20	2:40	4:20	2:30(1°)	4:10
2:30	3:15	5:05	3:15(4°)	5:05	3:20	5:15	3:10(5°)	5:10
3:00	3:50	5:55	3:50(7°)	5:55	4:00	6:10	3:55(7°)	6:10
3:30	4:30	6:45	4:25(8°)	6:40	4:40	7:00	4:40(8°)	7:05
4:00	5:10	7:35	5:05(9°)	7:35	5:35	8:05	5:30(9°)	8:05
4:30	5:50	8:15	5:45(9°)	8:15	6:30	9:05	6:25(9°)	9:00
5:00	6:30	9:00	6:25(9°)	9:00	7:20	10:00	7:25(9°)	10:00
5:30	7:10	9:55	7:10(9°)	9:40	8:20	11:05	8:25(8°)	11:00
6:00	7:40	11:00	7:35(10°)	11:05	9:10	12:00	9:20(8°)	11:55
6:30	8:10	12:10	8:05(12°)	12:10	10:05	13:00	10:15(7°)	12:50
7:00	8:45	13:05	8:35(13°)	13:05	10:50	13:40	11:05(7°)	13:40
7:30	9:20	14:00	9:10(14°)	14:00	11:35	14:25	11:50(7°)	14:25
8:00	10:00	14:55	9:40(15°)	14:50	12:15	15:15	12:25(7°)	15:10
8:30	10:35	15:45	10:05(17°)	15:35	12:45	16:00	13:00(8°)	15:55
9:00	11:10	16:20	10:25(17°)	16:35	13:00	16:35	13:20(11°)	16:35
9:30	11:45	16:55	10:50(18°)	17:05	13:20	17:10	13:35(12°)	17:10
10:00	12:20	17:30	11:25(18°)	17:45	13:40	17:40	13:55(13°)	17:40

Notes:
1. All pitch rates are 5° per second.
2. Begin pitch at specified time to indicated attitude ( ).
3. T_1 and T_2 are measured with respect to PDI.
4. Aborts on the APS after 10 min use the manual ascent angles.