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Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: 70-FM73-344

JAN 20 1971

MEMORANDUM TO: FS/Chief, Flight Support Division

FROM : FM/Chief, Mission Planning and Analysis Division

SUBJECT : Final prelaunch erasable load parameters for Apollo 14 flight programs using January 31, 1971 launch date

The enclosure to this memorandum defines the final Apollo 14 prelaunch erasable load parameters for COLOSSUS IIE and LUMINARY ID that have been assigned to the Mission Planning and Analysis Division (MPAD). As requested by the Flight Support Division (FSD), MPAD is to supply to the Apollo Guidance Program Section (AGPS) the preliminary and final values for the specified erasable quantities. The Guidance and Performance Branch (GPB) of the MPAD has coordinated with the appropriate MPAD branches for the definition of those parameters, and they are listed in the table (enclosure). It should be noted that certain of the parameters are a function of the launch date. The enclosed table contains values which are valid for a January 31, 1971 launch date. Any questions or comments concerning the erasable load should be directed to Aldo Bordano or to Wayne Steifle, extension 4491.

John P. Mayer

Enclosure

cc:
(See attached page)

CMC Name	Description	Final Value	
NO.PASS	Number of passes of P24 before landmark coordinate update	16383	
RTED1	First coefficient defining high speed V-γ target line polynomial	1.6602637	
DVTHRESH	Threshold value of ΔV which must be sensed in two second period or SPS thrust failure is indicated	2.0 ft/sec	0.6096E-2 m/cs
HORIZALT	Horizon altitude		28000.0 m
ALTVAR	COAS angular error variance		0.152168E-4 $(rad)^2$
EMDOT	SPS mass flow rate	67.5 lb/sec	0.3061748498 kg/cs
UN1TW[1]	Polar axis unit vector in reference coordinates		.2949684858E-4 .3619492054E-4 .99999999627
EK1VAL	SPS impulse acquired from a one second burn	19965.7 lb-sec	888.118583 kg.m./cs
EK2VAL	SPS minimum impulse constant used to estimate burn time when burn time is less than 1.0 sec.	4909.1 lb-sec	218.36764731 kg.m./cs
EK3VAL	SPS minimum impulse constant equal to the slope of the minimum impulse curve. Used to estimate burn time when burn time is less than 1.0 sec.	24874.8 lb	11.0648623 $kg.m./(cs)^2$

CMC Name	Description		Final Value
FANG	SPS thrust used to estimate burn time when burn time is less than 6 sec.	20390 lb	9.069924 $kg.m./(cs)^2$
E3J22R2M	Product of J22 lunar potential coeff., μ moon, radius of the moon squared, and 3.0		92.04790479E+15 $m^5/(cs)^2$
E32C31RM	Product of C(3,1) lunar potential coeff., μ moon, radius of the moon cubed, and 1.5		13.12892560E+22 $m^6/(cs)^2$
WRENDPOS	W matrix initialization for rendezvous navigation	10000.0 ft.	3048.0 m
WRENDVEL	W matrix initialization for rendezvous navigation	10.0 fps	0.03048 m/cs
RMAX	Rendezvous navigation position update threshold limit	2000.0 ft.	609.60 m
VMAX	Rendezvous navigation velocity update threshold limit	2.0 fps	0.6096E-2 m/cs
WORBPOS	W matrix initialization for orbital navigation	0.0	
WORBVEL	W matrix initialization for orbit navigation	0.0	
S22WSUBL	W matrix initialization for orbital navigation	32808.4 ft.	10000.0 m
RPVAR	Primary body radius error variance		4000000.0 m^2

CMC Name	Description	Final Value
504LM[1]	Lunar libration correction vector in moon-fixed coordinates	-.34365057945E-3 rad .14255568385E-3 rad .11800974607E-3 rad
EMSALT	EMS initialization altitude	293597.2 ft 8.948842656E+04 m
RLS[4]	Lunar landing site radius vector	1.65322750E+06 m -5.20128000E+05 m -1.11264500E+05 m
TIMEMO[1]	Time at center of range over which lunar position polynomial is valid	.19159158790E+10 cs
VECOEM[1]	Lunar position polynomial coefficients	$\underline{C}_0$ - $\underline{C}_9$ (meters, centiseconds)

$\underline{C}_0$ m	$\underline{C}_1$ m/cs	$\underline{C}_2$ m/(cs)^2	$\underline{C}_3$ m/(cs)^3
-.133852808+009	-.943798065+001	.417344257-007	.973160124-015
.334525168+009	-.243675053+001	-.106991180-006	.360700510-015
.167399016+009	-.186354661+001	-.536265219-007	.249689484-015

$\underline{C}_4$ m/(cs)^4	$\underline{C}_5$ m/(cs)^5	$\underline{C}_6$ m/(cs)^6	$\underline{C}_7$ m/(cs)^7
-.331005405-023	-.198584430-031	.905583878-040	-.728524143-049
.487997915-023	-.176658169-031	-.273681472-040	.105824778-048
.236106779-023	-.105202630-031	-.886478925-041	.516464798-049

$\underline{C}_8$ m/(cs)^8	$\underline{C}_9$ m/(cs)^9
.977266209-057	-.956685405-065
-.716852466-057	.179612512-064
-.316187517-057	.883805300-065

CMC Name	Description	Final Value	
RESO[1]	Position vector of sun at TIMEMO		.11019807437E+12 m -.90029257728E+11 m -.39038976000E+11 m
VESO[1]	Velocity vector at sun at TIMEMO		.20073042107E+3 m/cs .20681486130E+3 m/cs .89672367096E+2 m/cs
OMEGAES[1]	Angular velocity of solar position vector at TIMEMO		.32556352059E-9 rev/cs
INTVAR	Coasting integration error variance		196.0 m^2
LAUNCHAZ[1]	Desired azimuth of the stable member X-axis east of true north	72.066946E+00 deg	.2001859611 rev
WMIDPOS	W matrix initialization for cislunar midcourse navigation	30000.0 ft	9144.0 m
WMIDVEL	W matrix initialization for cislunar midcourse navigation	30 ft/sec	0.09144 m/cs
RVAR	VHF range error variance	0.0	
RVARMIN	VHF minimum range error variance	-40000.0 ft^2	-3716.1216 m^2
LADPAD	Reference L/D ratio	0.27	
LODPAD	Final phase reference L/D ratio	0.207	
ALFAPAD	Hypersonic value of angle of attack (α) for CM in trimmed flight	-19.06 deg	-5.294444445E-02 rev
P37RANGE	Nominal inertial range from 300,000 ft altitude to target	1187.35 n.mi.	

CMC Name	Description	Final Value	
ETDECAY	Value subtracted from time-to-go which compensates for SPS thrust tailoff	.69 sec	69.0 cs
PACTOFF	Pitch angle to CSM c.g. at insertion	-1.416 deg	
YACTOFF	Yaw angle to CSM c.g. at insertion	1.314 deg	
LEMMASS	LM mass (at transposition and docking)	33678.4 lb	15276.27 kg
CSMMASS	CSM mass (at transposition and docking)	64457.1 lb	29237.25 kg
POLYNUM	Boost monitor pitch polynomial degree information	5	
	Boost monitor pitch polynomial coefficients, A_0 - A_6	0.14051760E+00 deg 0.22886283E+00 deg/sec 0.44197154E-02 deg/(sec)^2 0.10997650E-04 deg/(sec)^3 -0.14904606E-06 deg/(sec)^4 -0.23591821E-08 deg/(sec)^5 0.13334313E-10 deg/(sec)^6	
SATRLRT	Boost roll rate	1.0 deg/sec	0.27777777E-4 rev/cs
RPSTART	Time from liftoff to start boost polynomial and booster roll	12.60 sec	1260.0 cs
POLYSTOP	Time increment after RPSTART to stop boost polynomial and hold display of attitude error constant	-150.0 sec	-15000.0 cs

CMC Name	Description	Final	Value
HORISLP	Slope of function used for horizon altitude computation		0.0
LAT (SPL)	Entry target data for boost aborts, latitude	+26.48 deg. (north, geodetic)	.0735555555 rev.
LNG (SPL)	Entry target data for boost aborts, longitude	-17.05 deg. (west)	-0.0473611111 rev.

LUMINARY ID

LGC Name	Description		Final Value
MASS	Total vehicle mass (CSM/LM separation)	34150.2 lb	15490.27015 kg
LEMMASS	LM mass (at CSM/LM separation)	34150.2 lb	15490.27015 kg
CSMMASS	CSM mass (at CSM/LM separation)	36524.5 lb	16567.23452 kg
E3J23R2M	Product of J22 lunar potential coefficient, μ_{moon}, radius of the moon squared, and 3.0		9.20479047931E+16 $m^5/(cs)^2$
E32C31RM	Product of C(3,1) lunar potential coefficient, μ_{moon}, radius of the moon cubed, and 1.5		1.31289255968E+23 $m^6/(cs)^2$
TOOFEW	Minimum number of consecutive ROD calculations required before bypass the issuing of program alarm in P-66		3.00000000
X789	Vector containing the best estimate of bias necessary to offset the rendezvous radar pointing error	0.0 rad 0.0 rad 0.0 rad	
-AYO[1]	True to mean pole rotation about the -Y axis		2.949684858E-5 rad
AXO[1]	True to mean pole rotation about the +X axis		3.619492054E-5 rad

LGC Name	Description	Final Value
REFSMMAT	Nominal descent REFSMMAT	-5.5645563-01
REFSMMAT+2		-7.4666660-01
REFSMATT+4		-3.6448062-01
REFSMATT+6		1.7753813-01
REFSMATT+8		-5.3538851-01
REFSMATT+10		8.2573564-01
REFSMATT+12		-8.1168795-01
REFSMATT+14		3.9477605-01
REFSMATT+16		4.3048175-01

LGC Name	Description	Final Value	
RANGEVAR	Variance expected in measured range	1.111111111E-5	
RATEVAR	Variance expected in measured range rate	1.877777778E-5	
RVARMIN	Minimum rendezvous radar range error variance		66.0 $(\text{meters})^2$
VVARMIN	Minimum rendezvous radar range rate error variance		1.7445E-6 $(\text{meters/cs})^2$
WRENDPOS	1st - 3rd diagonal components of W-matrix	10000 ft	3048.0 m
WRENDVEL	4th - 6th diagonal components of W-matrix	10 ft/sec	.03048 m/cs
WSHAFT	7th diagonal component of W-matrix		0.015 rad.
WTRUN	8th diagonal component of W-matrix		0.015 rad.
RMAX	Maximum value of rendezvous position update allowed without astronaut approval	2000.0 ft.	609.6 m
VMAX	Maximum value of rendezvous velocity update allowed without astronaut approval	2.0 ft/sec	0.006096 m/cs

LGC Name	Description	Final Value	
WSURFPOS	Variance in spacecraft position on the surface	0.0 ft	0.0 meters
WSURFVEL	Variance in spacecraft velocity on the surface	0.0 ft/sec	0.0 meters/cs
SHAFTVAR	Variance associated with the measured value of the rendezvous radar shaft angle		0.000001 $(rad)^2$
TRUNVAR	Variance associated with the measured value of the rendezvous radar trunnion angle		0.000001 $(rad)^2$
504LM[1]	Lunar libration correction vector in moon-fixed coordinates		-.34365057945E-3 rad .14255568385E-3 rad .11800974607E-3 rad
RLS[4]	Lunar landing site radius vector		1.653227500E+06 m -5.201280000E+05 m -1.112645000E+05 m
TLAND	Nominal time of lunar landing	1.089202417E+02 hr GET	3.9211287.0 cs GET
VELBIAS	Velocity portion of LR reasonability test	2.50000000 ft/sec	7.62000000E-03 m/cs
RBRFG	Hi-gate position aimpoint vector in the descent guidance coordinate system	-1773.725 ft 0.0 -14488.027 ft	-540.63138 m 0.0 -4415.9506 m
RAPFG	Low gate position aimpoint vector in the descent guidance coordinate system	94.9191 ft 0.0 -15.7208 ft	28.931342 m 0.0 -4.7916998 m
VBRFG	Hi-gate velocity aimpoint vector expressed in the descent guidance coordinate system	-168.10646 ft/sec 0.0 -77.614367 ft/sec	-.51238848 m/cs 0.0 -.23656859 m/cs

LGC Name	Description	Final Value	
VAPFG	Low gate velocity aimpoint vector expressed in the descent guidance coordinate system	2.08358 ft/sec 0.0 0.83031879 ft/sec	6.3507518E-03 m/cs 0.0 2.5308117E-03 m/cs
ABRFG	Hi-gate acceleration aimpoint vector expressed in the descent guidance coordinate system	-.64723603 ft/(sec)^2 0.0 -8.4143819 ft/(sec)^2	-1.9727754E-05 m/(cs)^2 0.0 -2.5647036E-04 m/(cs)^2
AAPFG	Low gate acceleration aimpoint vector expressed in the descent guidance coordinate system	0.54028500 ft/(sec)^2 0.0 -0.235423 ft/(sec)^2	1.6467887E-05 m/(cs)^2 0.0 -7.1756930E-06 m/(cs)^2
VBRFG*^{2}	Z component of VBRFG multiplied by 18	-1397.0586 ft/sec	-4.2582346 m/cs
VAPFG*^{2}	Z component of VAPFG multiplied by 18	14.945738 ft/sec	4.5554609E-02 m/cs
ABRFG*	Z component of ABRFG multiplied by 6	-50.486293 ft/(sec)^2	-1.5388222E-03 m/(cs)^2
AAPFG*	Z component of AAPFG multiplied by 6	-1.4125380 ft/(sec)^2	-4.3054158E-05 m/(cs)^2
JBRFG*^{3}	Hi-gate jerk aimpoint, Z component only	8.2572949E-03 ft/(sec)^3	2.5168235E-09 m/(cs)^3
JAPFG*^{3}	Low gate jerk aimpoint, Z component only	0.045092421 ft/(sec)^3	1.3744170E-08 m/(cs)^3
GAINBRAK	Gain constant used in the orientation of the descent guidance system in P63	1.0	
GAINAPPR	Gain constant used in the orientation of the descent guidance coordinate system in P64	0.0	

LGC Name	Description	Final Value	
TCGFBRAK	Latest time guidance frame is erected in braking phase	30 sec	3000.0 cs
TCGIBRAK	Earliest time guidance frame is erected in braking phase	900 sec	90000.0 cs
TCGFAPPR	Latest time guidance frame is erected in approach phase	6.0 sec	600.0 cs
TCGIAPPR	Earliest time guidance frame is erected in approach phase	200 sec	20000.0 cs
VIGN	Speed desired at ignition, relative to the rotating moon	5.5464472E+03 ft/sec	1.6905571E+01 m/cs
RIGNX	X component of desired position relative to the landing site. Expressed in the descent guidance coordinate system	-1.4034573E+05 ft	-4.2777378E+04 m
RIGNZ	Z component of desired position relative to the landing site (desired cross range component is zero)	-1.4649800E+06 ft	-4.4652590E+05 m
KIGNX/B4	Landing site vertical error scale factor used in the ignition-time test quantity	-.419	
KIGNY/B8	Cross range error scale factor	-9.05E-07 ft/ft^2	-2.96916010E-6 m^{-1}
KIGNV/B4	Speed error scale factor used in the ignition-time test quantity	-470.0 sec	-47000 cs
LOWCRIT	Upper limit on the variable throttle region in a situation of decreasing thrust commands	5985 lb	2124.4 DPS throttle pulses

LGC Name	Description		Final Value
HIGHCRIT	Upper limit on the variable throttle region in a situation of increasing thrust commands	6615.0 lb	2348.0 DPS throttle pulses
TAUHZ	Time constant for nulling horizontal velocity in P-66 auto		5.0000000E+02 cs
QHZ	Feedback constant for previous acceleration level		4.0000000E-01
AHZLIM	Maximum horizontal acceleration in auto P-66	1.9389800 ft/sec^2	5.9100110E-05 m/cs^2
2LATE466	Maximum time after start of servicer cycle for which 2nd ROD calculations will be started	1.50 sec	1.5000000E+02 cs
DELQFIX	LR data reasonableness test parameter	500.0 ft	152.400 m
LRVMAX	Maximum limit for velocity calculations that are allowed to be updated by the LR	2500.0 ft/sec	7.6200 m/cs
LRVF	Value at which velocity update coefficients are changed	200.0 ft/sec	0.6096 m/cs
LRWVZ	Weighting factor for LR Z-axis velocity update	0.3	
LRWVY	Weighting factor for LR Y-axis velocity update	0.3	
LRWVX	Weighting factor for LR X-axis velocity update	0.3	
LRWVFZ	LR velocity weighting function	0.2	

LGC Name	Description	Final Value	
LRWVFY	LR velocity weighting function	0.2	
LRWVFX	LR velocity weighting function	0.2	
LRWVFF	Weighting factor used for P66	0.1	
ABSC0	Range to I^{th} segment of lunar terrain	-2.3800000E+05 ft	-7.2542399E+04 m
ABSC1		-5.7000000E+04 ft	-1.7373600E+04 m
ABSC2		-4.9000000E+04 ft	-1.4935200E+04 m
ABSC3		-1.1200000E+04 ft	-3.4137600E+03 m
ABSC4		-5.0000000E+03 ft	-1.5240000E+03 m
SLOPE0	Slope of I^{th} segment of lunar terrain model		-1.1050000E-02 rad
SLOPE1			-1.0880000E-01 rad
SLOPE2			3.7040000E-02 rad
SLOPE3			-7.9030000E-02 rad
SLOPE4			-1.2000000E-02 rad
RODSCALE	Click scale factor for rate of descent	1.0 ft/sec	0.30480E-2 m/cs
TAUROD	Time constant for rate of descent	1.5 sec	150.0 cs
LAG/TAU	Lag time divided by TAUROD (P66)	0.23333	
MINFORCE	Minimum thrust P66 will command	980.0 lb	0.43592571 kg.m./$(cs)^2$

LGC Name	Description	Final Value	
MAXFORCE	Maximum thrust P66 will command	6300.0 lb	2.8023796 kg.m./(cs)^2
J1PARM	Parameter used in the computation of insertion velocity for aborts if the LM to CSM phase angle existing at the time of abort is less than THETCRIT	6046952.7 ft	1843111.18 m
K1PARM	Same definition as J1PARAM	-315027.79 ft/rad	-603314.409 m/rev
J2PARM	Parameter used in the computation of insertion velocity for aborts if the LM to CSM phase angle existing at the time of abort is greater or equal to THETCRIT	6048609.9 ft	1843616.30 m
K2PARM	Same definition as J2PARAM	-627630.26 ft/rad	-1201984.05 m/rev
THETCRIT	Central angle switching criteria	-1.741421853E+01 deg	-.483728293E-1 rev
RAMIN	The minimum apolune radius allowed for aborts from powered descent	5880068.25 ft	1792244.8 m
YLIM	Maximum cross range distance in aborts	8.2 n.mi.	15186.4 m
ABTRDOT	Desired radial velocity for aborts	19.5 ft/sec	0.594360E-1 m/cs
COSTHET1	Cosine 90°. Cosine of cone 1 angle for aborts. Used to determine direction of attitude rotation to preferred abort attitude.	0.0	

LGC Name	Description	Final Value	
COSTHET2	Cosine 30°. Cosine of cone 2 angle for aborts. Used to determine direction of attitude rotation to preferred abort attitude.	0.8660254037	
HIASCENT	Upper bound on the mass of the ascent stage	10900.0 lb	4944.1568 kg.
ROLLTIME	Time to drive the DPS gimbal around the R-axis, starting at the hard stop, to position it prior to PDI	26.40 sec	2640 cs
PITTIME	Time to drive the DPS gimbal around the Q-axis, starting at the hard stop, to position it prior to PDI	21.93 sec	2193 cs
IGNAOSQ	Initial DAP estimate of offset acceleration about the Q-axis	6.027 deg/(sec)^2	1.6741667E-2 rev/(sec)^2
IGNAOSR	Initial DAP estimate of offset acceleration about the R axis	-0.016 deg/(sec)^2	-4.4444445E-5 rev/(sec)^2
LRHMAX	Maximum limit for altitude calculations that are allowed to be updated by the LR	50000.0 ft	15240.0 m
LRWH	Weighting factor for incorporation of LR altitude measurements into the LM state vector during breaking phase	0.35	
ZOOMTIME	Time after ignition to raise the DPS to full throttle position	26.0 sec	2600 cs

LGC Name	Description	Final Value	
TENDBRAK	Controls time of transition from P63 to P64	62.0 sec	6200 cs
TENDAPPR	Controls time of transition from P64 to P66	12.0 sec	1200 cs
DELTTFAP	Time increment added to t_{go} when switching from P63 to P64	-90.0 sec	-9000.0 cs
LEADTIME	Time increment specifying how far guidance is projected forward in P63 and P64	-2.2 sec	-220.0 cs
RPCRTIME	Time from the end of the present descent guidance phase at which the LR may be repositioned to position 2	62.0 sec	6200 cs
RPCRTQSW	Required X component of the X-body axis in platform coordinates at the time of LR reposition to position 2	-1.0	
TNEWA	Cycle period at which Lambert solution updates A-steer target parameters	15.53 days	134217728.0 cs ($20000\ 00000_8$)
LRWH1	Weighting factor for incorporation of LR altitude measurements into the LM state vector during approach phase		.0.35000

LM State Vector at LOI Ignition

X	2712381.2 ft
Y	5083053.0 ft
Z	2386843.2 ft
DX	6498.74 fps
DY	-4178.83 fps
DZ	-2259.19 fps
T	82 hr 38 min 13.46 sec GET

[1]These values are valid for a launch date of January 31, 1971.

[2]To achieve the proper octal value in the LGC, this number should be scaled B13.

[3]To achieve the proper octal value in the LGC, this number should be scaled B-21.

[4]FRA MAURO landing site used for January 31, 1971 launch date.