APPENDIX A

AS-503 C' GUIDANCE PRESETTINGS FOR LAUNCH WINDOWS 20 THROUGH 27 DECEMBER 1968

This appendix gives the guidance presettings for December 1968. Table A-1 presents the launch date independent presettings. Tables A-2 through A-9 contain the launch date dependent presettings.

TABLE A-1

GUIDANCE PRESETTINGS INDEPENDENT OF LAUNCH DATE

Accelerometer Processing Parameters

Boeing Symbol	Program Symbol	Comments	Presetting
F_1	F_1	S-IC thrust	35,148,897.
F_2	F_2	S-II thrust before EMR	5,052,268.5
F_3	F_3	S-II thrust after EMR	457.5
F_4	F_4	S-IVB first burn thrust	873,480.1
F_{4A}	F_{4A}	S-IVB abort thrust before EMR	873,480.1
F_4'	F4AP	S-IVB abort thrust after EMR	873,480.1
F_5	F_5	S-IVB second burn thrust before EMR	900,495.03
F_6	F_6	S-IVB second burn thrust after EMR	900,495.03
F_{NR}	FNR	Nominal S-IVB thrust at re-ignition	911,663.02
$\dot{M}_1$	MDOT1	S-IC mass flow rates	14,316.19
$\dot{M}_2$	MDOT2	S-II mass flow rates before EMR	1,221.1489
$\dot{M}_3$	MDOT3	S-II mass flow rate after EMR	950.4154
$\dot{M}_4$	MDOT4	S-IVB first burn mass flow rates	208.7674
$\dot{M}_{4A}$	MDOT4A	S-IVB abort mass flow rate before EMR	215.037
$\dot{M}_4'$	MDOT4P	S-IVB abort mass flow rate after EMR	215.037
$\dot{M}_5$	MDOT5	S-IVB second burn mass flow rates before EMR	215.2241
$\dot{M}_6$	MDOT6	S-IVB second burn mass flow rate after EMR	215.2241

$\dot{M}_{NR}$	MDOTNR	Nominal mass flow rate at reignition	218.1035
	MASS1	Mass at lift-off	2,781,733.
	MASS2	Mass at start of S-II burn	634,858.1
	MASS3	Mass at start of S-IVB first burn	159,401.6
M_{NR}	MNR	Nominal mass of S-IVB at reignition	128,457.36
TS2S	AP1	Time from TB3 for first pass through S-II (M/F) smoothing filter. (Time from TB3 to S-II 90% thrust)	4.4
DELTIG	TS4BS1	Time from TB4 for first pass through S-IVB (M/F) smoothing filter	6.5
TSB4S*	TS4BS	Time from TB4A for first pass through S-IVB (M/F) smoothing filter	15.1
TS2AP	GS3	Time from TB3 to change reasonableness test constants (RTCS)	4.4
T4BAP	S4IGNA	Time from TB4 to change RTCS	12.0
T4BRAP	S4IGTR	Time from TB4A to change RTCS	584.

ADDITIONAL ABORT AND ALTERNATE MISSION PRESETTINGS

Boeing Symbol	Program Symbol	Comment	Presetting	Units
S4IGNP	S4IGNP	Time from TB4A at which time the reasonableness test constants are changed.	15.1	sec
T6	T6	Time to end χ_y freeze following an S-IC engine failure	0.0	sec
TE01		S-IC engine out single pass logic gate	0.0	
TE02		S-II engine out single pass logic	0.0	
1/TRP*	TRPS	Constants used to bias IGM pitch and yaw steering parameters for S-II/S-IVB direct staging	0.0	
1/TRY*	TRYS		0.0	
TB1A		Nominal transition time for S-IVB first burn engine mixture ratio shift	0.0	sec
ΔT_{COST}		Guidance coast time between direct staging ground-command update and S-IVB 1st 90% thrust	11.2	sec
ΔT_{4L}		Limit on difference between actual and nominal S-IVB first burn time	100.0	sec
ITLD*		Logic variable that determines proper IGM stage	0.0	

Pre-IGM Guidance Presettings

Boeing Symbol	Program Symbol	Comment	Presetting
t_3	B0	Constant freeze time for engine out prior to t_2	60.0
B_{11}	B11	Coefficients of polynomial to calculate delta freeze time in interval t_2 to t_4	-1.2
B_{12}	B12		67.2
B_{21}	B21	Coefficients of polynomial to calculate delta freeze time in interval of t_4 to t_5	0.0
B_{22}	B22		0.0
t_2	TFAIL1	Times to partition S-IC engine out freeze schedule	6.0
t_4	TFAIL2		56.0
t_5	TFAIL3		-1.0
t_2^+	TT2	Earliest time for CHIY freeze initiation for S-IC engine out	38.0
t_1	TT1	Time from TB1 to start pre-IGM guidance	13.0
ΔXNO	GANTRY	Tower clearance altitude	138.0
F_{10}	TTC10	Coefficients for first segment time tilt polynomial	-7.1630411×10^{0}
F_{11}	TTC11		1.7253733×10^{0}
F_{12}	TTC12		$-1.5609715 \times 10^{-1}$
F_{13}	TTC13		6.7969903×10^{-3}
F_{14}	TTC14		$-9.8395575 \times 10^{-5}$
F_{20}	TTC20	Coefficients for second segment time tilt polynomial	1.8767424×10^{1}
F_{21}	TTC21		-1.7854092×10^{0}
F_{22}	TTC22		7.2670840×10^{-2}
F_{23}	TTC23		$-9.6384562 \times 10^{-4}$
F_{24}	TTC24		4.6459679×10^{-6}
F_{30}	TTC30	Coefficients for third segment time tilt polynomial	9.6837640×10^{2}
F_{31}	TTC31		-4.4114144×10^{1}
F_{32}	TTC32		7.5386128×10^{-1}
F_{33}	TTC33		$-5.5607764 \times 10^{-3}$
F_{34}	TTC34		1.5154014×10^{-5}

	TTC40	Coefficients for fourth segment time tilt polynomial	9.3999818×10^{1}
F10	TTC41		-3.1154338×10^{0}
F11	TTC42		5.1115549×10^{-2}
F12	TTC43		$-3.0934483 \times 10^{-4}$
F13	TTC44		6.5909332×10^{-7}
F14			
TP1	TTSEG2	Time to use second time tilt segment coefficients	26.55
TP2	TTSEG3	Time to use third time tilt segment coefficients	70.55
TP3	TTSEG4	Time to use fourth time tilt segment coefficients	101.55
TAR	TAR	Nominal time tilt guidance arrest time	145.7

Referenced from Time base 1

IGM GUIDANCE PRESETTINGS

Boeing Symbol	Program Symbol	Comment	Presetting	Unit
ΔT_{IGM}	GS4	Time to start IGM in TB3	40.6	sec
ART	ART	Time-to-go in S-II stage at which guidance is arrested	5.0	sec
C_0'	C0	Time to remain in artificial tau mode at S-II/S-IVB staging	10.0	sec
θ_T		Desired terminal flight-path angle for first S-IVB burn	0.0	deg
ΔV_{DT1}	DVB	Thrust decay velocity bias for first S-IVB burn	1.98215	m/s
ϵ_2	EPLN2	Time-to-go for CHI bar steering for first S-IVB burn	35.0	sec
BIAS1	IGB1A1	Thrust change detection bias for S-II stage	1000.0	m/s
t_{B1}	TB1	Time to remain in artificial tau mode calculations during S-II EMR shift	40.0	sec
TSMC1	TSMC	Time in TB3 to begin SMC	60.6	sec
TSMC2	TSMC2	Time in TB4 to begin SMC	15.0	sec
T_1	T1I	IGM phase 1 time-to-go	246.5	sec
T_2	T2I	IGM phase 2 time-to-go	81.5	sec
T_3'	T3P	IGM phase 3 time-to-go	144.4419	sec
τ_2	TAU2	Estimated time to deplete vehicle from S-II EMR	321.95309	sec
τ_3	TAU3	Estimated time to deplete S-IVB mass	661.53577	sec
τ_{3N}	TAUN	Nominal τ_3 used in the S-IVB first-burn artificial tau mode	661.53577	sec
T_C	TCI	S-IVB first burn coast time	6.5	sec

	T4N	Nominal first S-IVB burn time	152.66
T_{4N}	NOMT4	Nominal time from GRR to start of T4	536.44
	THSLP1	Time-to-go at start of high speed loop in first S-IVB burn	8.0
ΔT			
	VGRD1	Velocity guard for first burn high speed loop	300.0
V_{ex_1}	VEX1	Exhaust velocity for phase 1 IGM	4169.1205
V_{ex_2}	VEX2	Exhaust velocity for phase 2 IGM	4237.6003
V_{ex_3}	VEX3	Exhaust velocity for phase 3 IGM	4163.7846
PCO	PCO	Time to force S-II EMR after nominal	0.0
V_T	VT	Terminal velocity for first burn	7793.0429
R_T	XVT	Terminal radius for first burn	6563366.0
TPMR	IG2	Time before nominal S-II EMR to search for EMR shift	0.0
$\dot{M}_{2G}$	MDOT2G	Average mass flow rate during first stage of IGM	1218.3948
$\dot{M}_{3G}$	MDOT3G	Average mass flow rate during second stage of IGM	990.40009
R_{OV}	ROV	Bias constant for terminal range angle for S-IVB first burn	1.5
SMCG1	SMCG1	SMC gain for first boost	.05

Second S-IVB Burn IGM Presettings

Program Symbol	Comment	Presetting
GS1	Time to start IGM in TB6	584.0
EPLN2R	Time-to-go for CHI bar steering	30.0
IGBIA2	Thrust change detection bias	1000.0
T2IR	IGM phase 4 time-to-go	0.0
TAU2R	Time to deplete S-IVB mass from S-IVB reignition	684.5038
TB2	Time to remain in artificial tau mode during S-IVB EMR	1.0
THSLP2	Time-to-go at start of high speed loop	3.0
VGRD1	Velocity guard for high speed loop	300.
VEX2R	Exhaust velocity for phase 4 IGM	4183.5690
VEX3R	Exhaust velocity for phase 5 IGM	4183.5690
PCOR	Time to force S-IVB EMR after nominal	0.0
EPLN3R	Constant time for selection of guidance option which freezes the terminal conditions	30.0
IG7	Time to search for S-IVB EMR shift	0.0
MDOT5G	Average mass flow rate during fourth stage of IGM	217.6286
MDOT6G	Average mass flow rate during fifth stage of IGM	217.6286
ROVR	Bias constant for terminal range angle	-0.4
SMCG3	SMC gain	0.05

S-II Early Staging IGM Presettings

Program Symbol	Comment	Presetting
CF	Conversion factor used in calculation of T_{3I}	.088991
DTCOST	Guidance coast time	11.2
BPLN2A	Time-to-go for CH1 bar steering	35.0
IGBIA2A	Thrust change detection bias	-0.001
TB3A	Time to remain in artificial tau	1.0
TEMR	Nominal time from TBa at S-IVB EMR	355.0
T3MIN	Minimum T_{3I}	45.0
VEX3A	Exhaust velocity of S-IVB before EMR	4188.624
VEX3B	Exhaust velocity of S-IVB after EMR	4188.624
PCOA	Time after nominal S-IVB EMR to force staging of guidance equations	2.0
ROVS	Bias constant for terminal range angle	.75
SMCG2	SMC gain	.05
S2COV	Nominal S-II velocity at cutoff	6816.467
FI0	Coefficients of the parking orbit inclination polynomial	32.55754
FI1		-15.84615
FI2		11.64780
FI3		9.89097
FI4		-5.11143
FI5		0.0
FI6		0.0

GL0	Coefficients of the parking orbit descending node polynomial	123.19350
GL1		-55.06485
GL2		-35.26208
GL3		26.01324
GL4		-1.47591
GL5		0.0
GL6		0.0

Miscellaneous Presettings

CKLAT	Cape Kennedy Latitude	28.608422
KSCLNG	Longitude of the launch pad	80.604133
KD	Orbital drag model constant (KD = ½ · area /mass)	.1317642 x 10^{-3}

Orbital Navigation Vent Model

VTIM1	Segment constants for vent model	1800
VTIM2		4300.0
VENT1A	Acceleration constants for vent model	.00129
VENT2A		.00062
VENT3A		.00043

TABLE A-3

IDANCE PRESETTINGS DEPENDENT UPON LAUNCH DATE OF DECEMBER 21, 1968

ng ol	Program Symbol	Comments	Presetting	Units
	TDS1	Partition times for the launch azimuth polynomial	7655.039	sec
	TDS2		16877.41	
	TDS3		0.0	
	TSD1	Times used to scale the launch azimuth polynomials	7655.039	
2	TSD2		9222.375	
	TSD3		0.0	
	TD1	Times of the opening or closing of launch window segment	0.0	
2	TD2		7655.039	
3	TD3		16877.41	
0	H10	Coefficients of the first segment of the launch azimuth polynomial	72.00731	deg
1	H11		23.78576	
12	H12		-9.22083	
13	H13		3.813349	
14	H14		-.38106	

h_{20}	H20	Coefficients of the second segment of the launch azimuth polynomial	90.00694	deg
h_{21}	H21		17.56239	
h_{22}	H22		-.23654	
h_{23}	H23		-.65216	
h_{24}	H24		1.31788	
h_{30}	H30	Coefficients of the third segment of the launch azimuth polynomial	0.0	
h_{31}	H31		0.0	
h_{32}	H32		0.0	
h_{33}	H33		0.0	
h_{34}	H34		0.0	
T_{LO}	TLO	GMT at the opening of the launch window	46222.43	sec
A_Z	AZO	Azimuth at the opening of the launch window	72.0	deg
	DVBRA	Thrust decay velocity bias (1st opportunity)	4.22	m/sec
	DVBRB	Thrust decay velocity bias (2nd opportunity)	4.22	m/sec
	AZS	Change in azimuth over launch window segment	36.0	deg
	TPA0	Time since launch window opening (1st opportunity)	0.0	sec
	TPA1		3360.905	
	TPA2		7655.044	
	TPA3		12404.73	
	TPA4		16877.42	
	TPA5		N/A*	
	TPA6			
	TPA7			
	TPA8			
	TPA9			

*Not Applicable.

TPA10			sec
TPA11			
TPA12			
TPA13			
TPA14			
TPB0	Time since launch window opening (2nd opportunity)	0.0	sec
TPB1		3360.905	
TPB2		7655.044	
TPB3		12404.73	
TPB4		16877.42	
TPB5		N/A	
TPB6			
TPB7			
TPB8			
TPB9			
TPB10			
TPB11			
TPB12			
TPB13			
TPB14			
C3A0	Twice the orbital energy of the target ellipse (1st opportunity)	-1.418676×10^6	m^2/sec^2
C3A1		-1.407036×10^6	
C3A2		-1.401780×10^6	
C3A3		-1.403856×10^6	
C3A4		-1.412868×10^6	
C3A5		N/A	
C3A6			
C3A7			
C3A8			
C3A9			
C3A10			
C3A11			
C3A12			
C3A13			
C3A14			

C3B0	Twice the orbital energy of the target ellipse (2nd opportunity)	-1.426555×10^6	m^2/sec^2
C3B1		-1.414405×10^6	
C3B2		-1.409265×10^6	
C3B3		-1.412021×10^6	
C3B4		-1.421996×10^6	
C3B5		N/A	
C3B6			
C3B7			
C3B8			
C3B9			
C3B10			
C3B11			
C3B12			
C3B13			
C3B14			

COSSA0	Cosine of the true anomaly of the target vector (1st opportunity)	.9905273
COSSA1		.9900422
COSSA2		.9899306
COSSA3		.9901525
COSSA4		.9907386
COSSA5		N/A
COSSA6		
COSSA7		
COSSA8		
COSSA9		
COSSA10		
COSSA11		
COSSA12		
COSSA13		
COSSA14		

COSSB0	Cosine of the true anomaly of the target vector (2nd opportunity)	.9857117
COSSB1		.9863396
COSSB2		.9864880
COSSB3		.9862899
COSSB4		.9856995
COSSB5		N/A
COSSB6		
COSSB7		
COSSB8		
COSSB9		
COSSB10		
COSSB11		
COSSB12		
COSSB13		
COSSB14		

ENA0	Eccentricity of the transfer ellipse (1st opportunity)	.9765474
ENA1		.9767366
ENA2		.8768212
ENA3		.9767865
ENA4		.9766392
ENA5		N/A
ENA6		
ENA7		
ENA8		
ENA9		
ENA10		
ENA11		
ENA12		
ENA13		
ENA14		

ENB0	Eccentricity of the transfer ellipse (2nd opportunity)	.9763992
ENB1		.9765974
ENB2		.9766807
ENB3		.9766345
ENB4		.9764704
ENB5		N/A
ENB6		
ENB7		
ENB8		
ENB9		
ENB10		
ENB11		
ENB12		
ENB13		
ENB14		

RASA0	Right ascension of the target vector (1st opportunity)	160.816	deg
RASA1		161.067	
RASA2		161.628	
RASA3		162.419	
RASA4		163.341	
RASA5		N/A	
RASA6			
RASA7			
RASA8			
RASA9			
RASA10			
RASA11			
RASA12			
RASA13			
RASA14			

RASB0	Right ascension of the target vector (2nd opportunity)	160.159	deg
RASB1		160.718	
RASB2		161.351	
RASB3		162.021	
RASB4		162.618	
RASB5		N/A	
RASB6			
RASB7			
RASB8			
RASB9			
RASB10			
RASB11			
RASB12			
RASB13			
RASB14			
DECA0	Declination of the target vector (1st opportunity)	10.8942	deg
DECA1		10.6265	
DECA2		10.3197	
DECA3		9.98609	
DECA4		9.7042	
DECA5		N/A	
DECA6			
DECA7			
DECA8			
DECA9			
DECA10			
DECA11			
DECA12			
DECA13			
DECA14			
DECB0	Declination of the target vector (2nd opportunity)	9.4362	deg
DECB1		9.4625	
DECB2		9.2217	
DECB3		8.7744	
DECB4		8.1619	
DECB5		N/A	
DECB6			
DECB7			
DECB8			
DECB9			
DECB10			
DECB11			
DECB12			
DECB13			
DECB14			

RESTART PARAMETERS

Boeing Symbol	Program Symbol	Comments	Presetting	Units
θ_{EO}	THEO	Angle between vernal equinox and launch meridian at the time of launch window opening (used for both opportunities)	202.142	deg
β_A	BETAA	Angle between $\underline{S}$ and the radius vector at chill-down initiation (1st opportunity)	56.497	deg
β_B	BETAB	Angle between S and the radius vector at chill-down initiation (2nd opportunity)	56.808	deg
α^*_{TS}	ALFTSA	Nominal angle between $\underline{S}$ and $\underline{TP}$ vectors at chill-down initiation (1st opportunity)	15.015	deg
α^*_{TS}	ALFTSB	Nominal angle between $\underline{S}$ and $\underline{TP}$ vectors at chill-down initiation (2nd opportunity)	15.997	deg
$FT(A_Z)$	TSTA	Time from T5 to begin SDOT·TP test (1st opportunity)	8002.341	sec
$FT(A_Z)$	TSTB	Time from T5 to begin SDOT·TP test (2nd opportunity)	13279.21	sec
γ	FA	True anomaly at target orbit injection (1st opportunity)	14.622	deg
γ	FB	True anomaly at target orbit injection (2nd opportunity)	13.706	deg

t_3	TAU3RA	Time to deplete S-IVB mass from S-IVB EMR (1st opportunity)	684.5038	sec
t_3	TAU3RB	Time to deplete S-IVB mass from S-IVB EMR (2nd opportunity)	682.1127	sec
R_N	RNA	Radius at nominal S-IVB reignition (1st opportunity)	6570592.	m
R_N	RNB	Radius at nominal S-IVB reignition (2nd opportunity)	6574182.	m
T'_3	T3PRA	IGM phase 5 time-to-go (1st opportunity)	310.8243	sec
T'_3	T3PRB	IGM phase 5 time-to-go (2nd opportunity)	308.6854	sec