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REVISION 2

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RTCC REQUIREMENTS
FOR MISSIONS F AND G:
EARTH ORBIT INSERTION PROCESSOR

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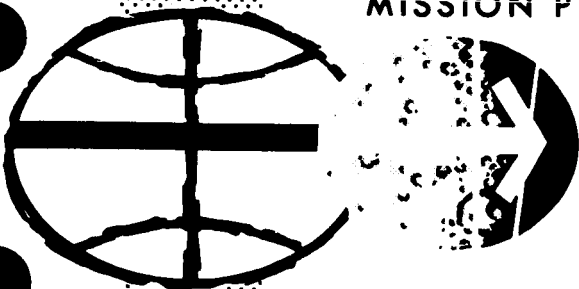
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Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS



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PROJECT APOLLO

REVISION 2
RTCC REQUIREMENTS FOR MISSIONS F AND G:
EARTH ORBIT INSERTION PROCESSOR

By Edward M. Jiongo
Lunar Mission Analysis Branch

March 7, 1969

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

Approved: Ronald L. Berry
Ronald L. Berry, Chief
Lunar Mission Analysis Branch

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

REVISION 2^a

RTCC REQUIREMENTS FOR MISSIONS F AND G;

EARTH ORBIT INSERTION PROCESSOR

By Edward M. Jiongo

SUMMARY AND INTRODUCTION

For Missions F and G, the Real-Time Computer Complex (RTCC) must be able to simulate the nominal S-IVB earth orbit insertion (EOI) conditions. This document describes the equation for the EOI processor and the associated logic that allows the flight controllers to obtain nominal earth orbit insertion conditions for any launch azimuth in the launch window (72° - 108°).

DISCUSSION OF THE PROCESSOR

The radius, flight-path angle, and circular velocity at EOI are assumed constant. The nominal conditions at EOI which must be computed are the time from lift-off, declination, longitude, and inertial azimuth. These are computed as a function of launch azimuth by the equation

$$Y = f(x) = A_0 + A_1x + A_2x^2 + A_3x^3$$

where x is the input launch azimuth in degrees and $A_0, \dots, A_3$ are the polynomial coefficients. A typical example of these coefficients is given in table I.

A typical example of the integrated flight trajectory data that are received from Marshall Space Flight Center is presented in table II. Normally, these data consist of at least five data points and are available at least 2 months or more prior to lift-off. The data in

^aThis revision supersedes MSC Internal Note 68-FM-283 dated November 29, 1968.

table II are curve fit as a function of launch azimuth by use of a least-squares technique. The altitude is 100 n. mi.; the flight-path angle is 0.0° ; and the velocity is 25 567.72868 fps.

A typical set of data that corresponds to the coefficients in table I is presented in table III for each launch azimuth from 72° to 108° . Positive longitude is east; negative, west. Positive latitude is north; negative, south.

TABLE I.- POLYNOMIAL COEFFICIENTS FOR EARTH PARKING ORBIT INSERTION CONDITIONS
AS A FUNCTION OF LAUNCH AZIMUTH FROM 72° TO 108°

Coefficients	Time from launch to EOI, sec	Declination of EOI, deg	Longitude of EOI, deg	Inertial azimuth of EOI, deg	Radius of EOI, n. mi.	Flight-path angle of EOI, deg	Inertial velocity of EOI, fps
A_0	0.76673814E3	0.60994221E2	-0.72323283E2	0.12344699E2	3.5439336 × 10 ³	0.0	25 567.72868
A_1	-0.18916781E1	-0.36710496E0	0.55465072E0	0.13104156E1	0.0	0.0	0.0
A_2	0.10202785E-1	-0.68781953E-3	-0.48610649E-2	-0.46697509E-2	0.0	0.0	0.0
A_3	0.16441395E-5	0.44783353E-5	0.90988410E-5	0.14584433E-4	0.0	0.0	0.0

TABLE II.- INTEGRATED EARTH PARKING ORBIT INSERTION CONDITIONS^a

(a) Variables

Launch azimuth, deg	Time from launch to EOI, sec	Declination, deg	Longitude, deg	Inertial azimuth, deg
72.0	684.0388	32.668	-54.191	87.931
81.0	681.3360	29.127	-54.456	95.600
90.0	680.3195	25.648	-55.148	103.088
99.0	681.0574	22.254	-56.224	110.461
108.0	683.5134	18.966	-57.660	117.773

(b) Constants

Radius, n. mi.	3543.9336
Inertial flight-path angle, deg	0.0
Inertial velocity, fps	25 567.72868

^aThese data were obtained from Marshall Space Flight Center February 21, 1969.

TABLE III.- TYPICAL DATA FOR EACH LAUNCH AZIMUTH

Launch azimuth, deg	Time, sec	Longitude, deg	Declination, deg	Inertial azimuth, deg
.72000000+02	684.0422000	-54.19206800	32.66853800	87.93024600
.73000000+02	683.6558700	-54.19879200	32.27231700	88.79352800
.73999999+02	683.2906500	-54.21125400	31.47668300	89.65386100
.75000000+02	682.9465000	-54.22939600	31.48166200	90.51132900
.76000000+02	682.6236200	-54.25316800	31.08728100	91.36602100
.77000000+02	682.3218400	-54.28251000	30.69356600	92.21802300
.77999999+02	682.0412100	-54.31747300	30.30054300	93.06742500
.79000000+02	681.7817700	-54.35770000	29.90824200	93.91431200
.80000000+02	681.5435100	-54.40343500	29.51668700	94.75877300
.80999999+02	681.3264400	-54.45452500	29.12590700	95.60089300
.82000000+02	681.1305800	-54.51091500	28.73592700	96.44076500
.83000000+02	680.9559400	-54.57255200	28.34677500	97.27847100
.84000000+02	680.8025200	-54.63937700	27.95897700	98.11410000
.84999999+02	680.6703300	-54.71134000	27.57106100	98.94774000
.86000000+02	680.5593700	-54.78838500	27.18455300	99.77948100
.87000000+02	680.4696800	-54.87045700	26.79898100	100.60940500
.88000000+02	680.4012600	-54.95750200	26.41437100	101.43760600
.89000000+02	680.3541100	-55.04944300	26.03074900	102.26416600
.90000000+02	680.3282300	-55.14629000	25.64614300	103.08917300
.91000000+02	680.3236600	-55.24792300	25.26658000	103.91271900
.91999999+02	680.3403900	-55.35431300	24.88608700	104.73488700
.93000000+02	680.3784300	-55.46540100	24.50668900	105.55576700
.94000000+02	680.4370000	-55.58113400	24.12841500	106.37544500
.95000000+02	680.5184900	-55.70345800	23.75129200	107.19400900
.96000000+02	680.6205300	-55.82631600	23.37534400	108.01154700
.97000000+02	680.7439200	-55.95565700	23.00060200	108.82814500
.98000000+02	680.8886800	-56.08942400	22.62709000	109.64389300
.98999999+02	681.0548100	-56.22756300	22.25483500	110.45887600
.10000000+03	681.2421000	-56.37002000	21.88386500	111.27318300
.10100000+03	681.4512100	-56.51674000	21.51420700	112.08690300
.10200000+03	681.6815100	-56.66766700	21.14588600	112.90012000
.10300000+03	681.9332300	-56.82274800	20.77893100	113.71292300
.10400000+03	682.2062700	-56.98192800	20.41336700	114.52540000
.10500000+03	682.5009300	-57.14515100	20.04922300	115.33763700
.10600000+03	682.8169400	-57.31236800	19.68652400	116.14972500
.10700000+03	683.1544000	-57.48351700	19.32529800	116.96175000
.10800000+03	683.5138300	-57.65854700	18.96557100	117.77379500