67-FM-23

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-23

February 10, 1967

LAUNCH AND COAST TIMES IN EARTH PARKING ORBIT FOR FREE-RETURN LUNAR MISSION FROM JANUARY 31 THROUGH JULY 9, 1968

By Edward M. Jiongo

Mission Analysis Branch

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Washington, D. C.

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MISSION PLANNING AND ANALYSIS DIVISION

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PROJECT APOLLO

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HOUSTON, TEXAS

Approved: M. P. Frank III, Chief
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Mission Planning and Analysis Division

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2 Elapsed time from launch versus latitude for launch azimuth 72° through 108°, (100 nautical mile altitude earth parking orbit)

(a) 72 degree launch azimuth 87
(b) 74 degree launch azimuth 88
(c) 76 degree launch azimuth 89
(d) 78 degree launch azimuth 90
(e) 80 degree launch azimuth 91
(f) 82 degree launch azimuth 92
(g) 84 degree launch azimuth 93
(h) 86 degree launch azimuth 94
(i) 88 degree launch azimuth 95
(j) 90 degree launch azimuth 96
(k) 92 degree launch azimuth 97
(l) 94 degree launch azimuth 98
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(n) 98 degree launch azimuth 100
(o) 100 degree launch azimuth 101
(p) 102 degree launch azimuth 102
(q) 104 degree launch azimuth 103
(r) 106 degree launch azimuth 104
(s) 108 degree launch azimuth 105

LAUNCH AND COAST TIMES IN EARTH PARKING ORBIT FOR FREE-RETURN LUNAR MISSION FROM JANUARY 31 THROUGH JULY 9, 1968

By Edward M. Jiongo

SUMMARY AND INTRODUCTION

This internal note presents figures showing the approximate time of launch for the following launch dates in 1968, which insure a free-return lunar mission:

Jan	31
Feb	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 29
Mar	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 30, 31
Apr	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 28, 29, 30
May	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 27, 28, 29, 30, 31
June	1, 2, 3, 4, 5, 6, 7, 8, 9, 26, 27, 28, 29, 30
July	1, 2, 3, 4, 5, 6, 7, 8, 9

All launch times given are for injection on the second revolution in earth parking orbit for the Pacific window only.

If the latitude of injection is known for a given launch day, then the coast time in earth orbit can be determined for launch azimuths of 72° through 108°.

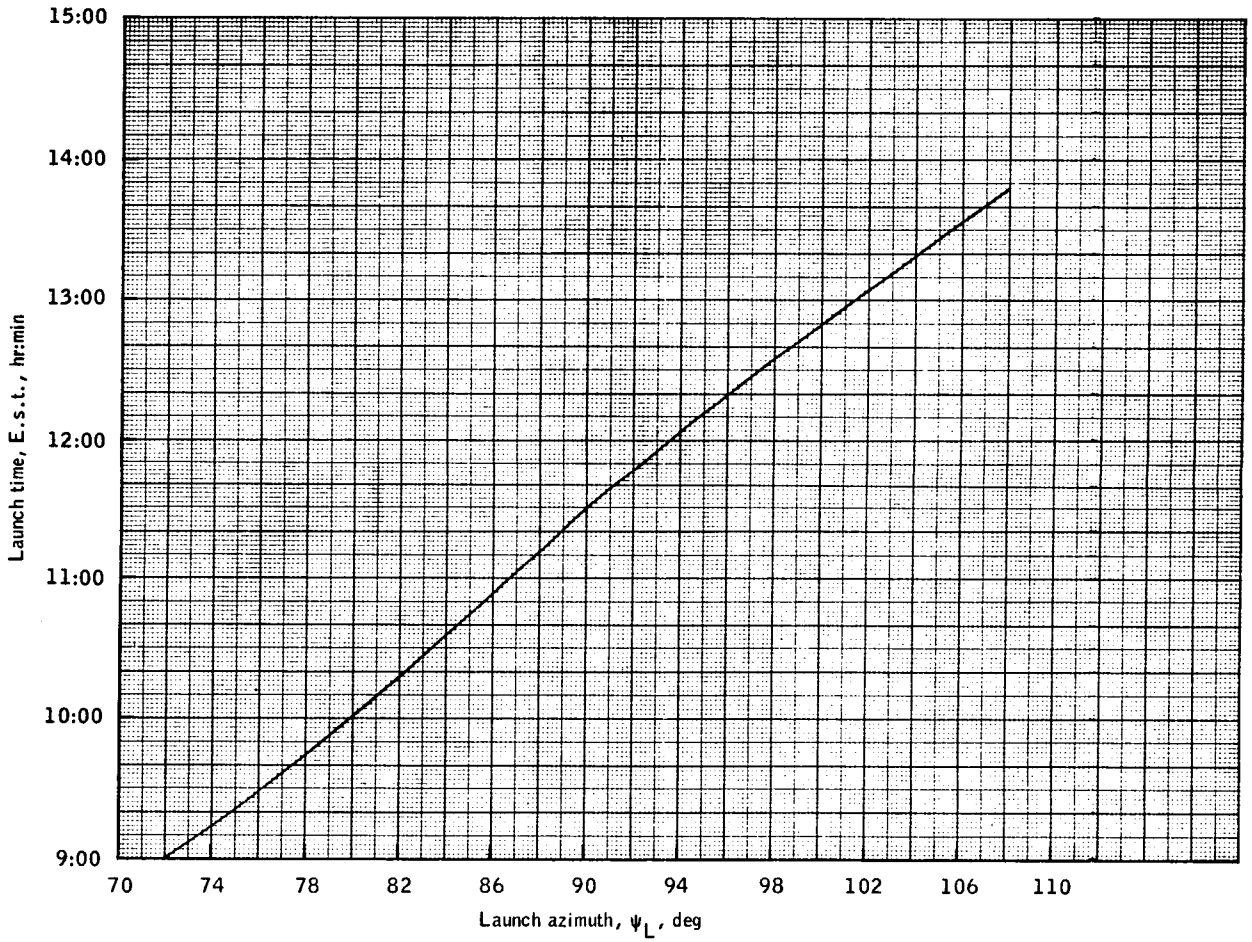
ANALYSIS AND RESULTS

The times of launch were generated using the A-13 matched conic program. Times of coast in earth parking orbit were generated using the Apollo Reference Mission Program. Insertion conditions were obtained from reference 2.

Figure 1 (a through ffff) shows the time of launch (E.s.t.) versus launch azimuths of 72° through 108°. There is a separate graph for each day studied. Figure 2 (a through s) shows elapsed time (hours) from launch versus latitude. The figures start at earth orbit insertion and terminate 4.5 hours from launch. There is a separate graph for each launch azimuth from 72° through 108° in increments of 2°.

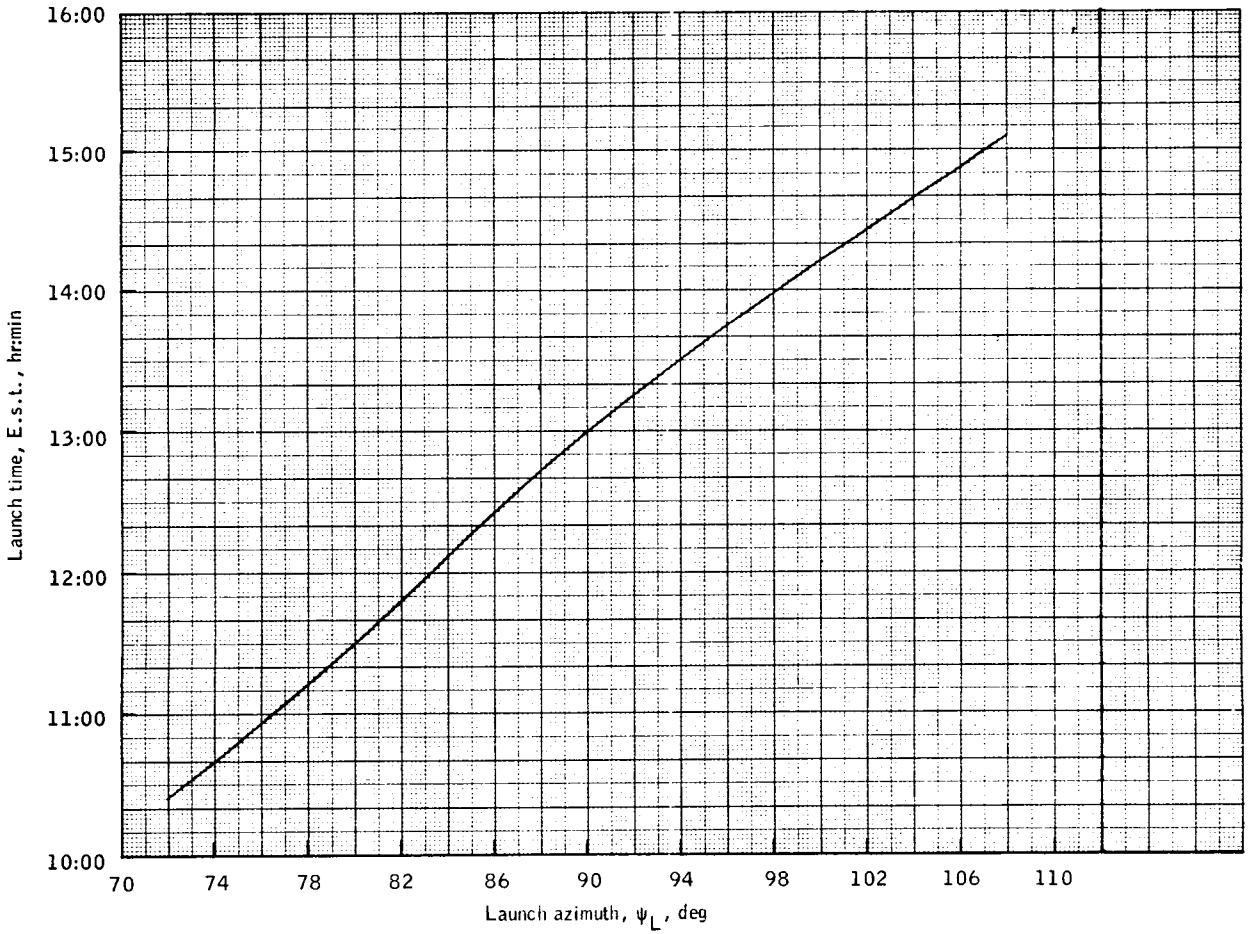
CONCLUSION

With these graphs, it is possible to closely approximate the time of launch for the first half of 1968 for free-return lunar missions. If in addition the latitude of the translunar injection burn is known, then the time of coast in earth orbit can be determined.



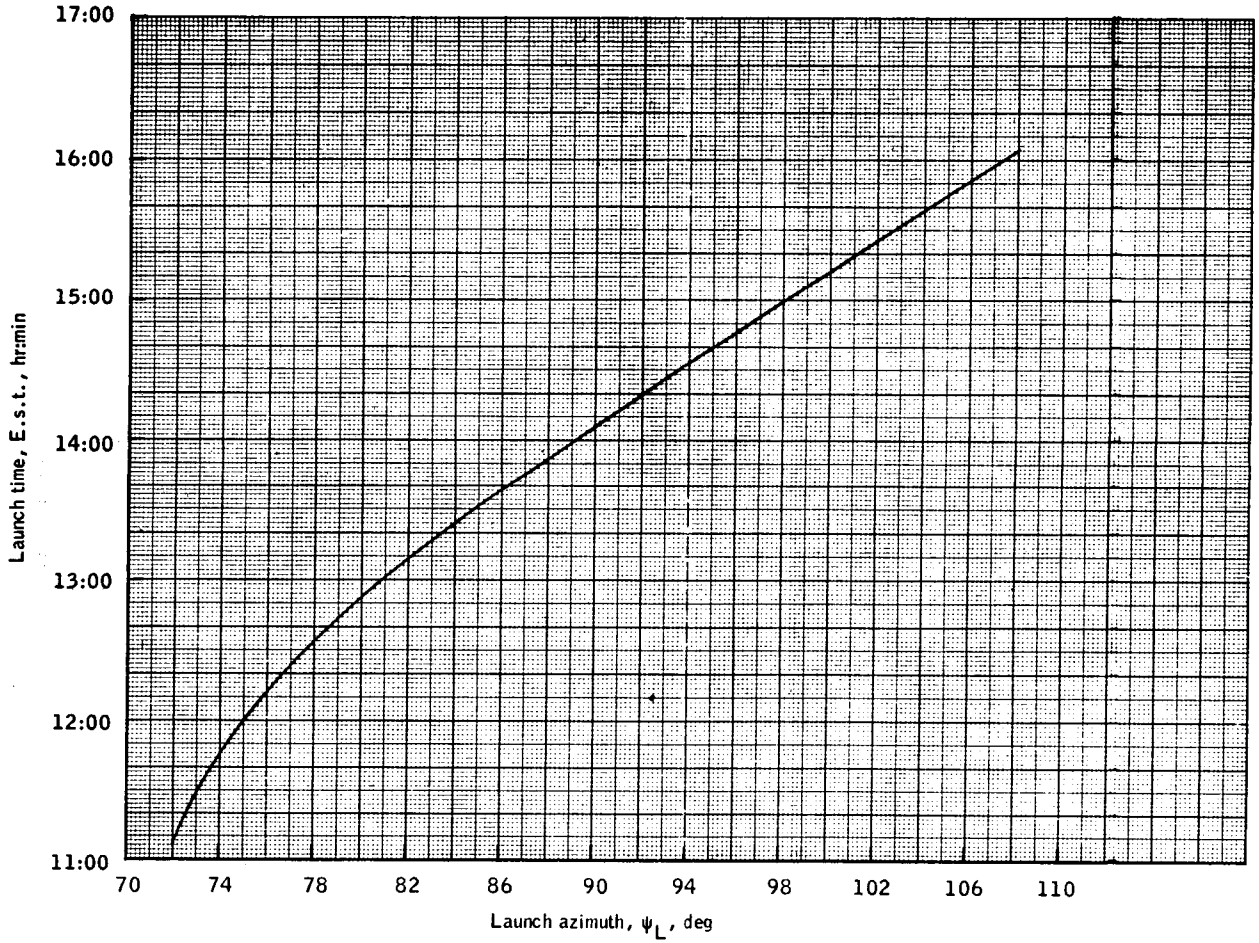
(a) January 31, 1968.

Figure 1.- Launch azimuth versus launch time, January 31, 1968 through July 9, 1968.



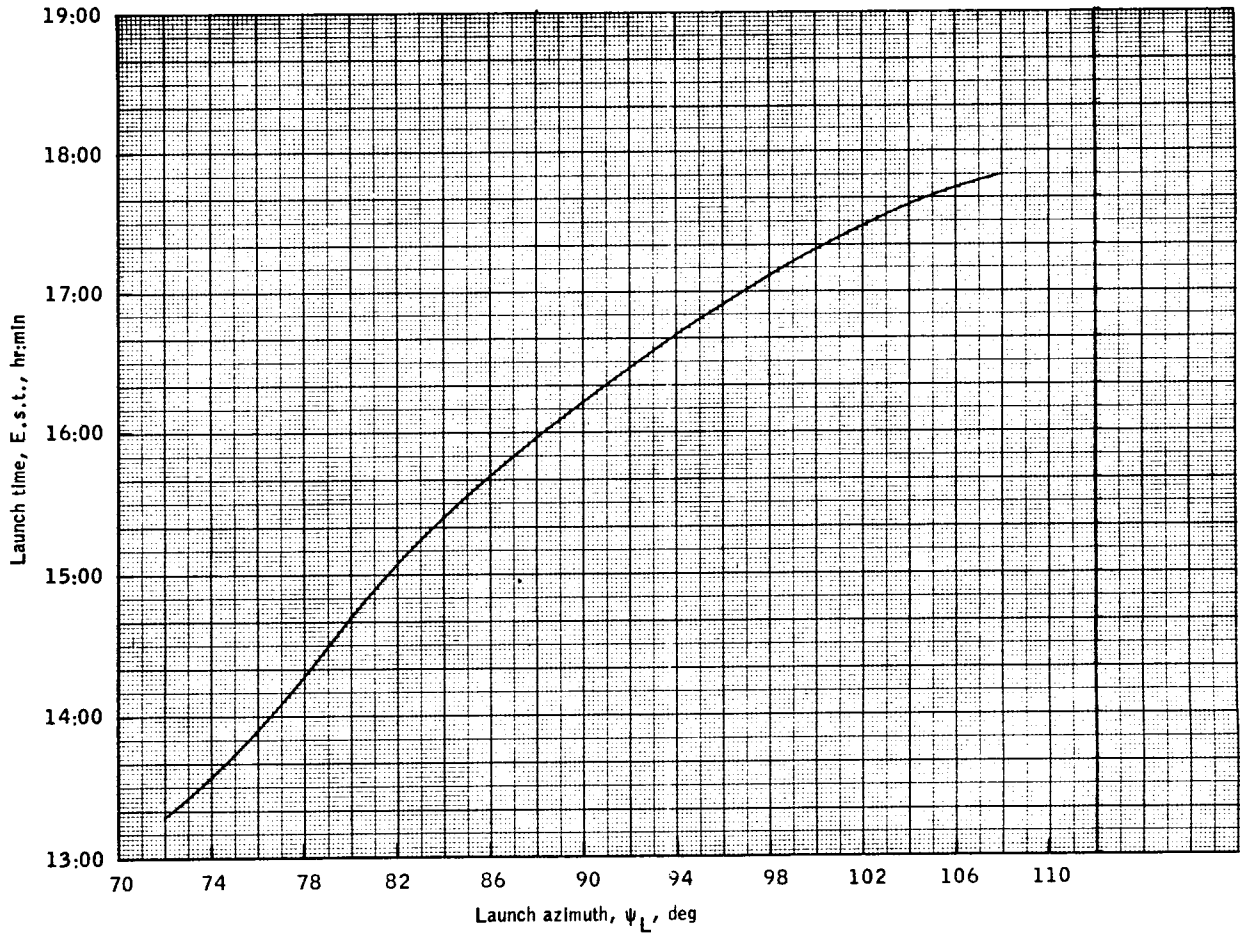
(b) February 1, 1968.

Figure 1.- Continued.



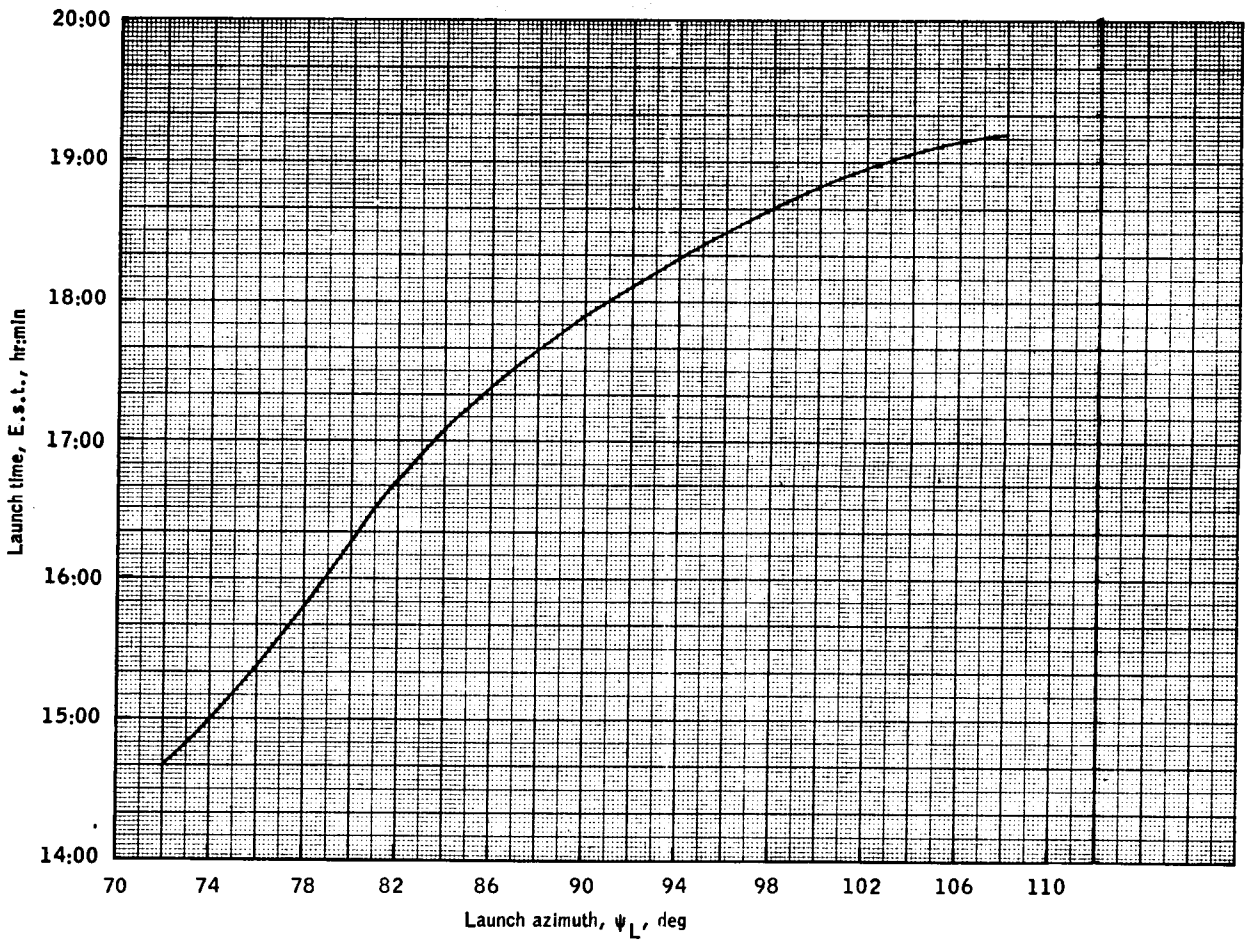
(c) February 2, 1968.

Figure 1.- Continued.



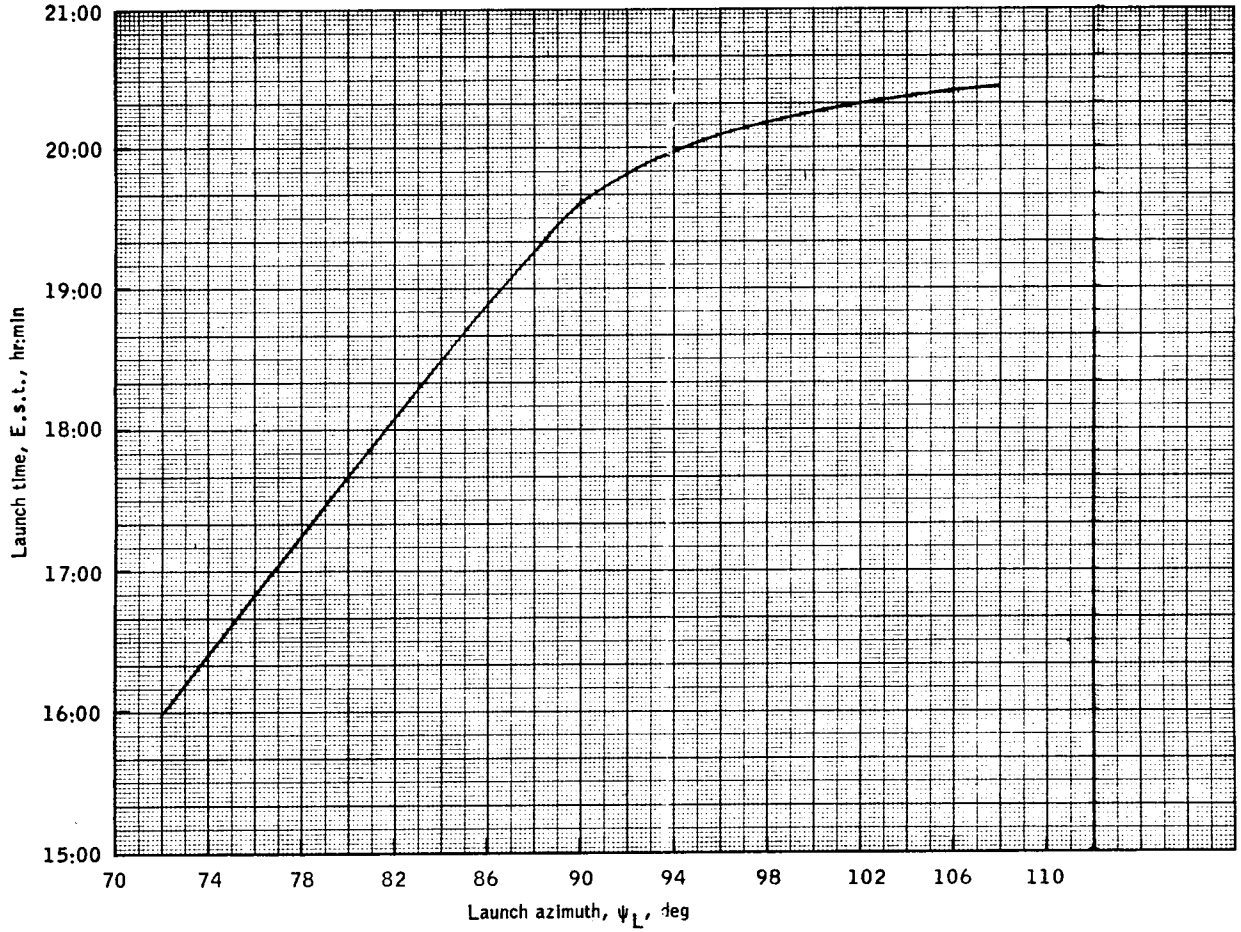
(d) February 3, 1968.

Figure 1.- Continued.



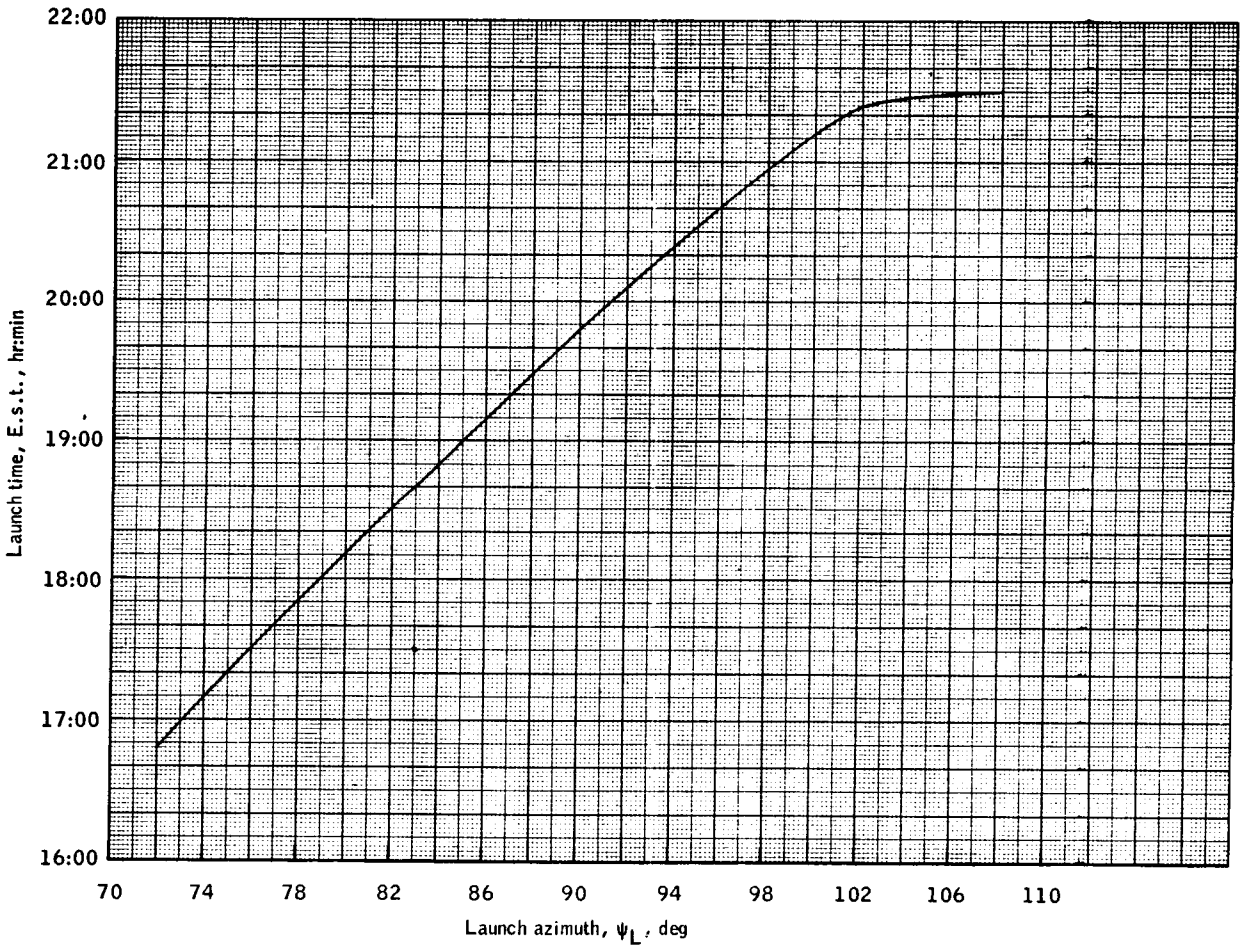
(e) February 4, 1963.

Figure 1.- Continued.



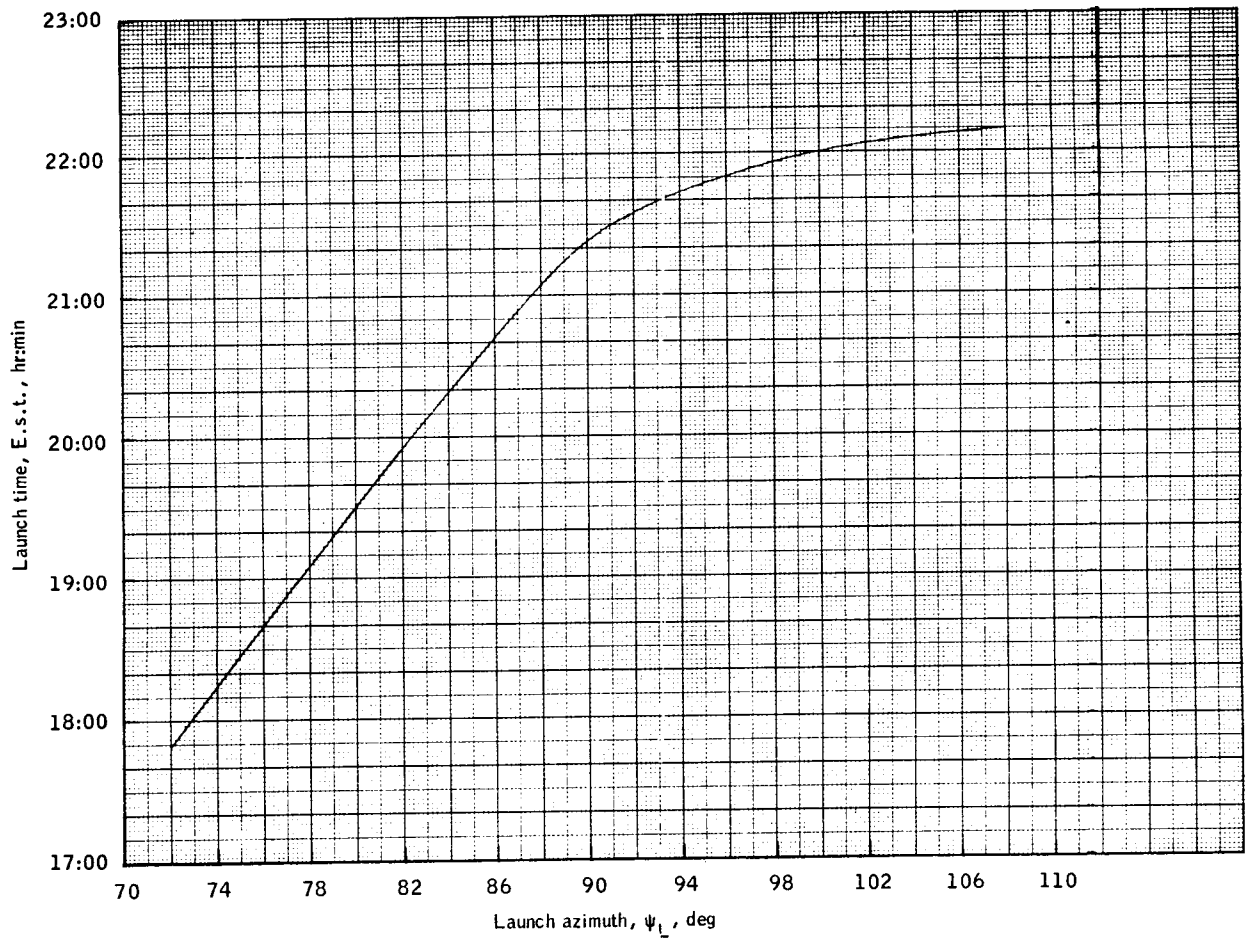
(f) February 5, 1963.

Figure 1. - Continued.



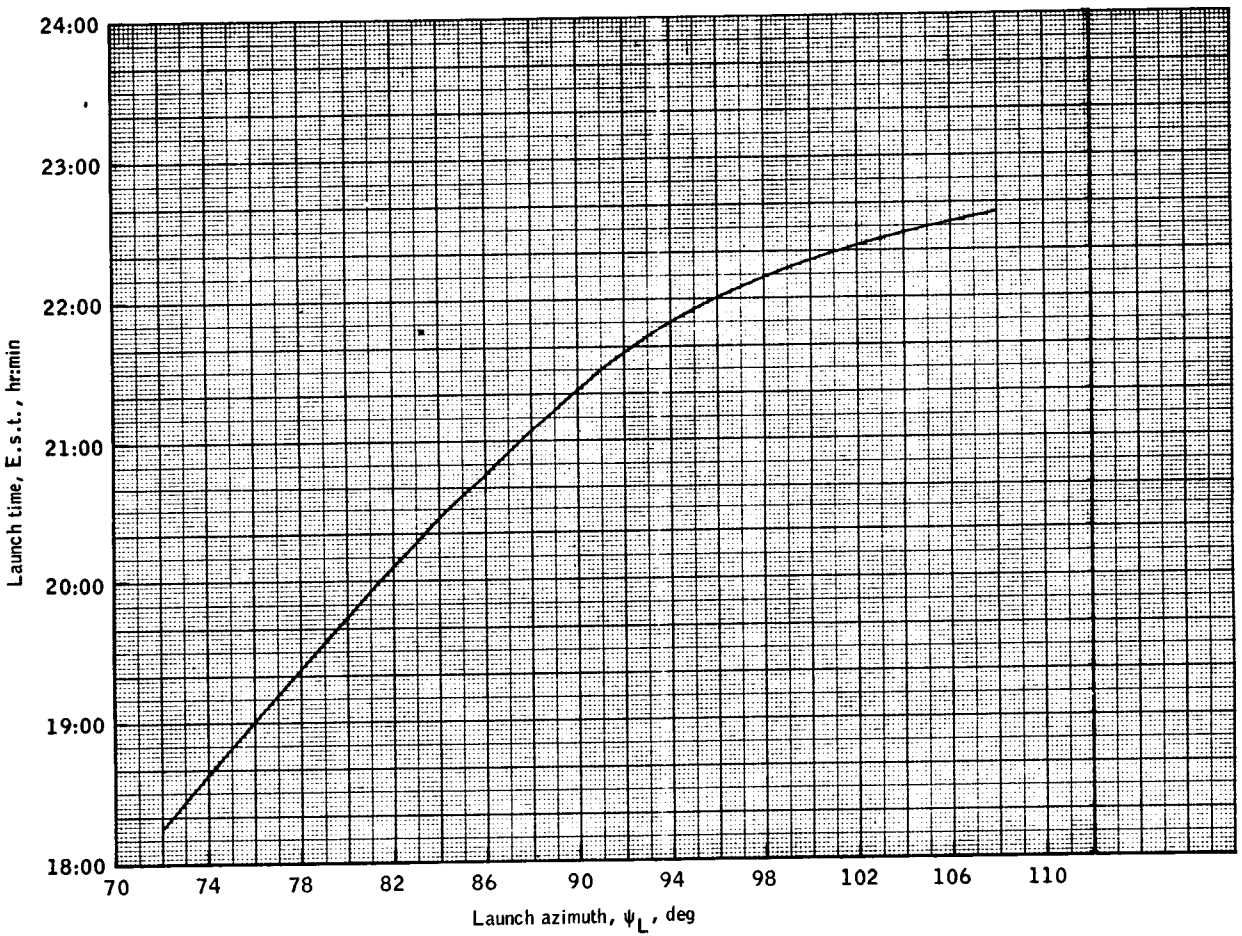
(g) February 6, 1968.

Figure 1.- Continued.



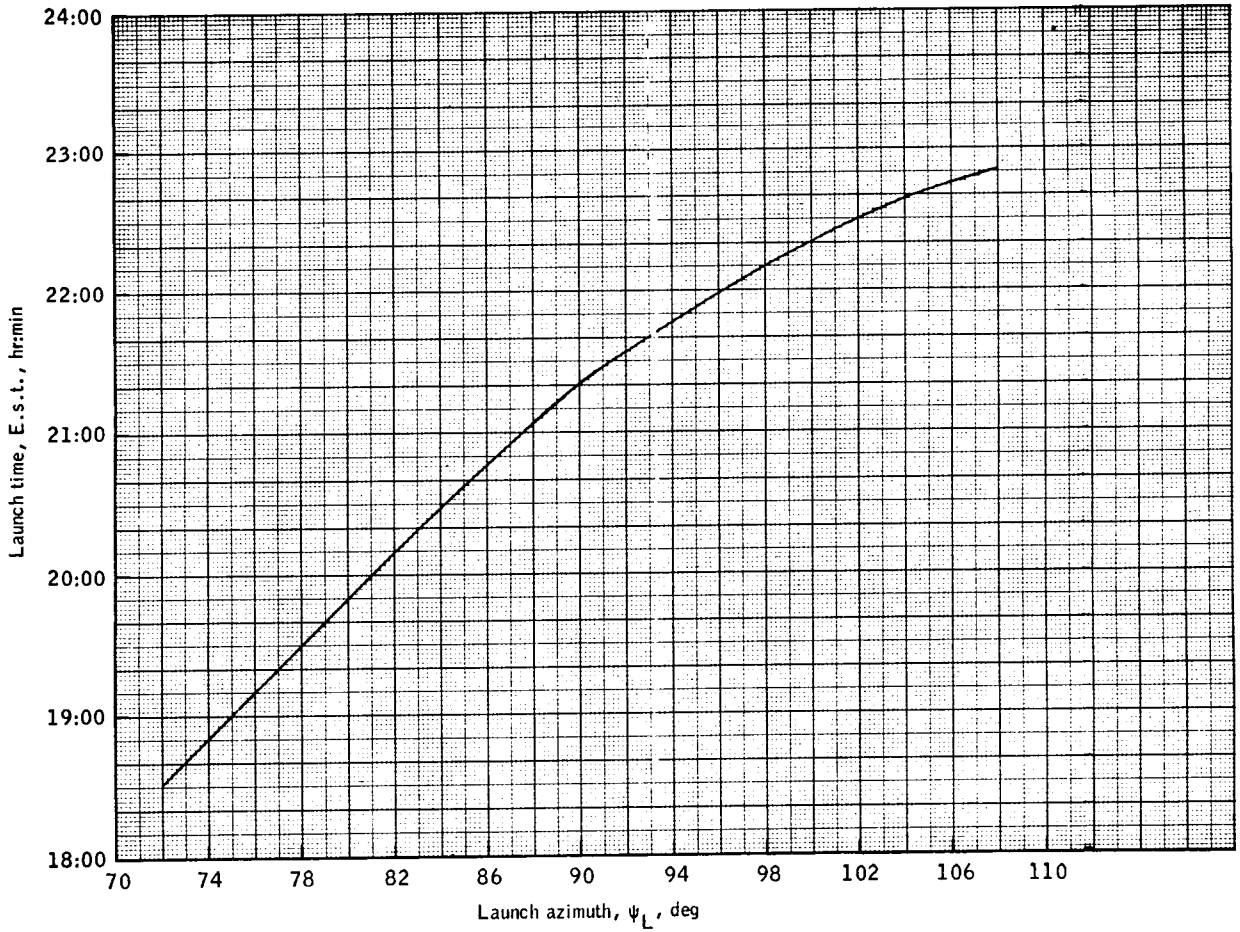
(h) February 7, 1968.

Figure 1.- Continued.



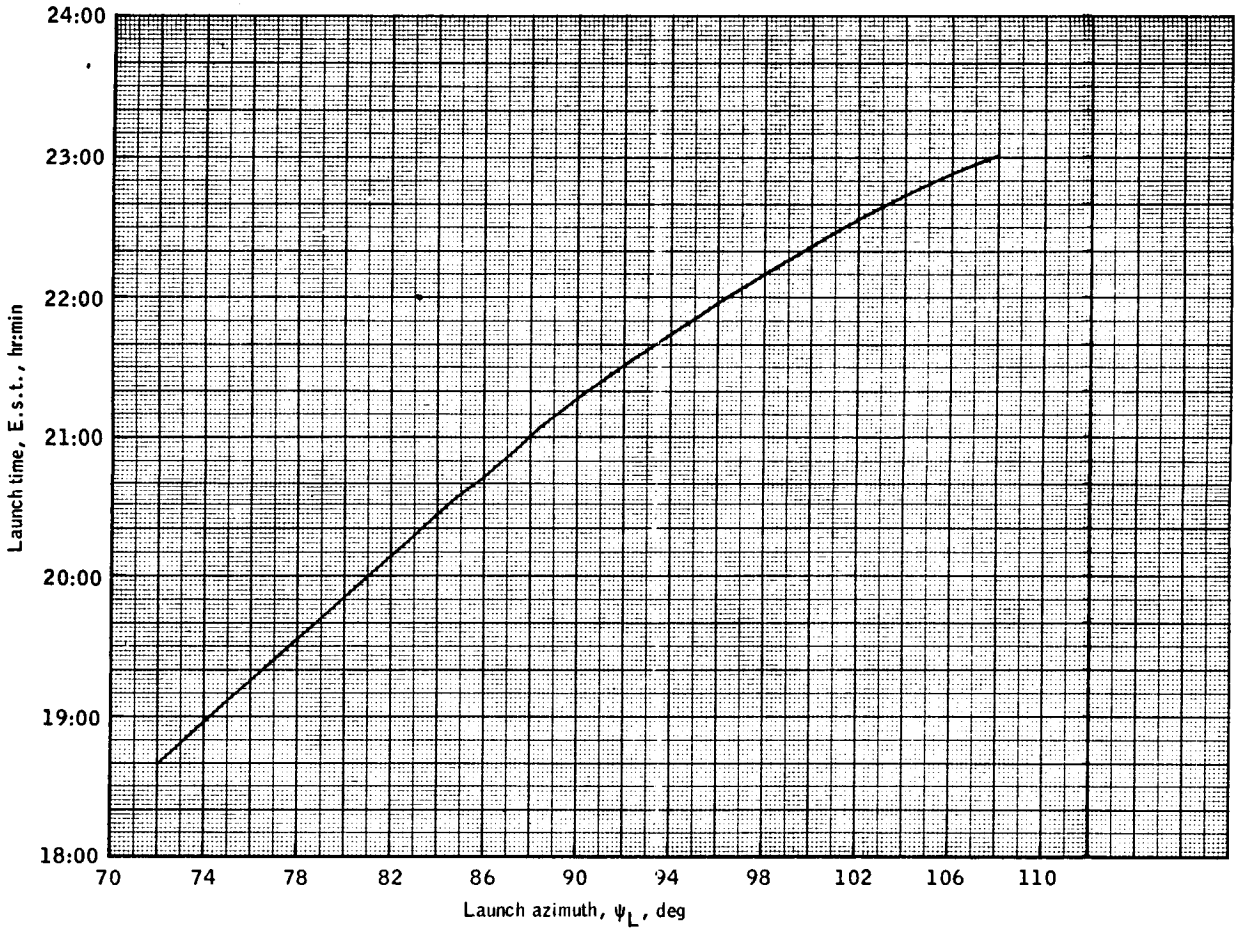
(l) February 8, 1968.

Figure 1.- Continued.



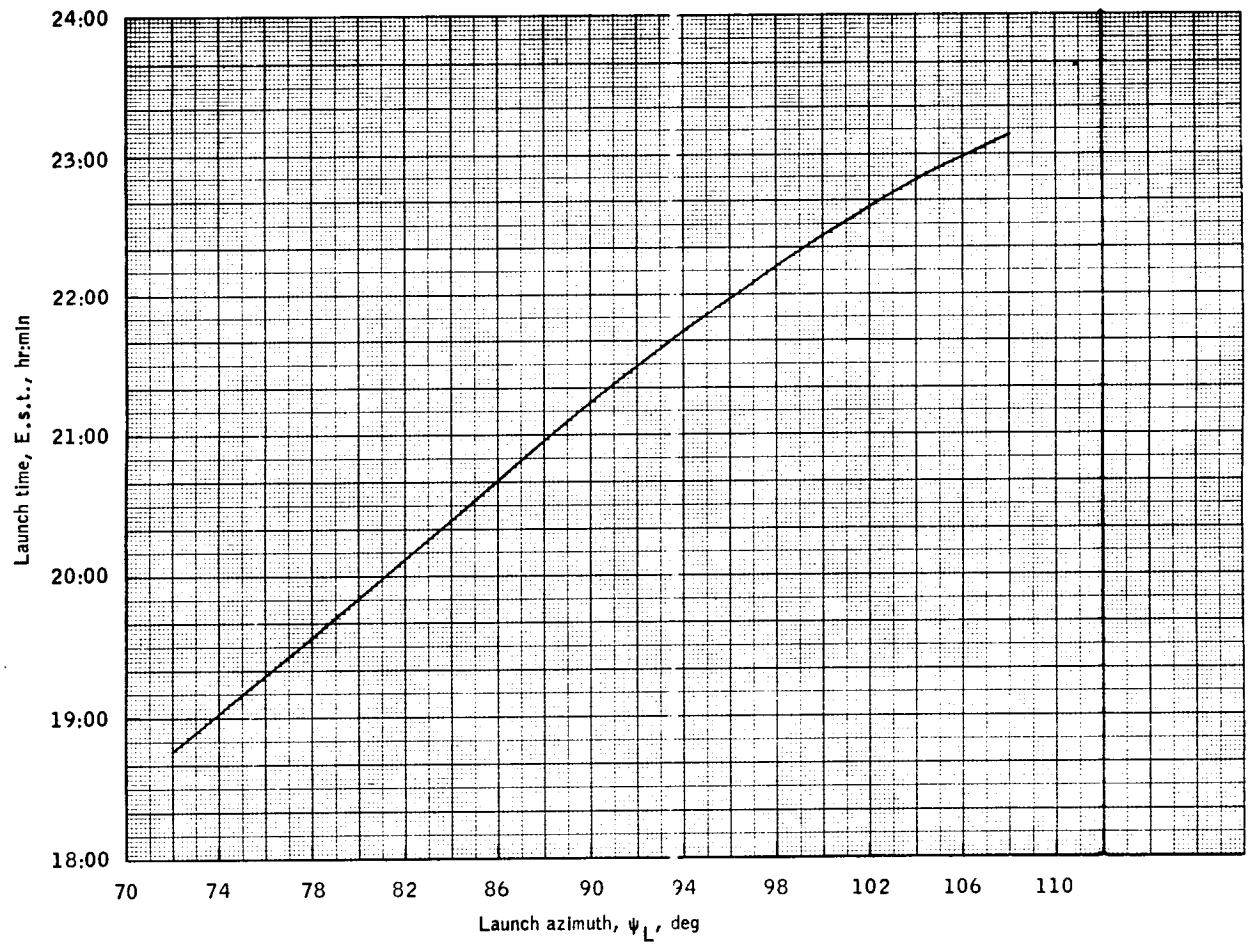
(j) February 9, 1968.

Figure 1.- Continued.



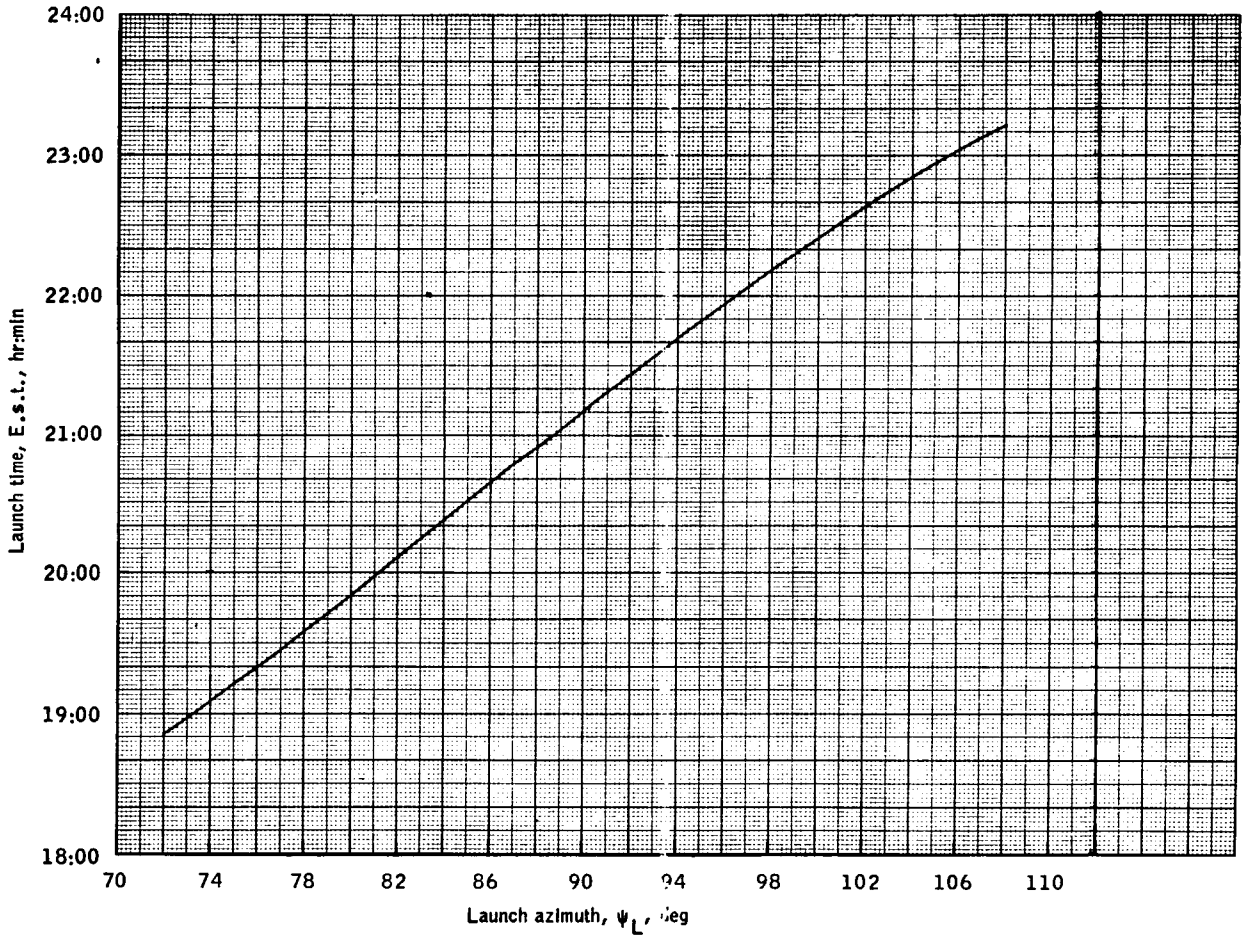
(k) February 10, 1968.

Figure 1.- Continued.



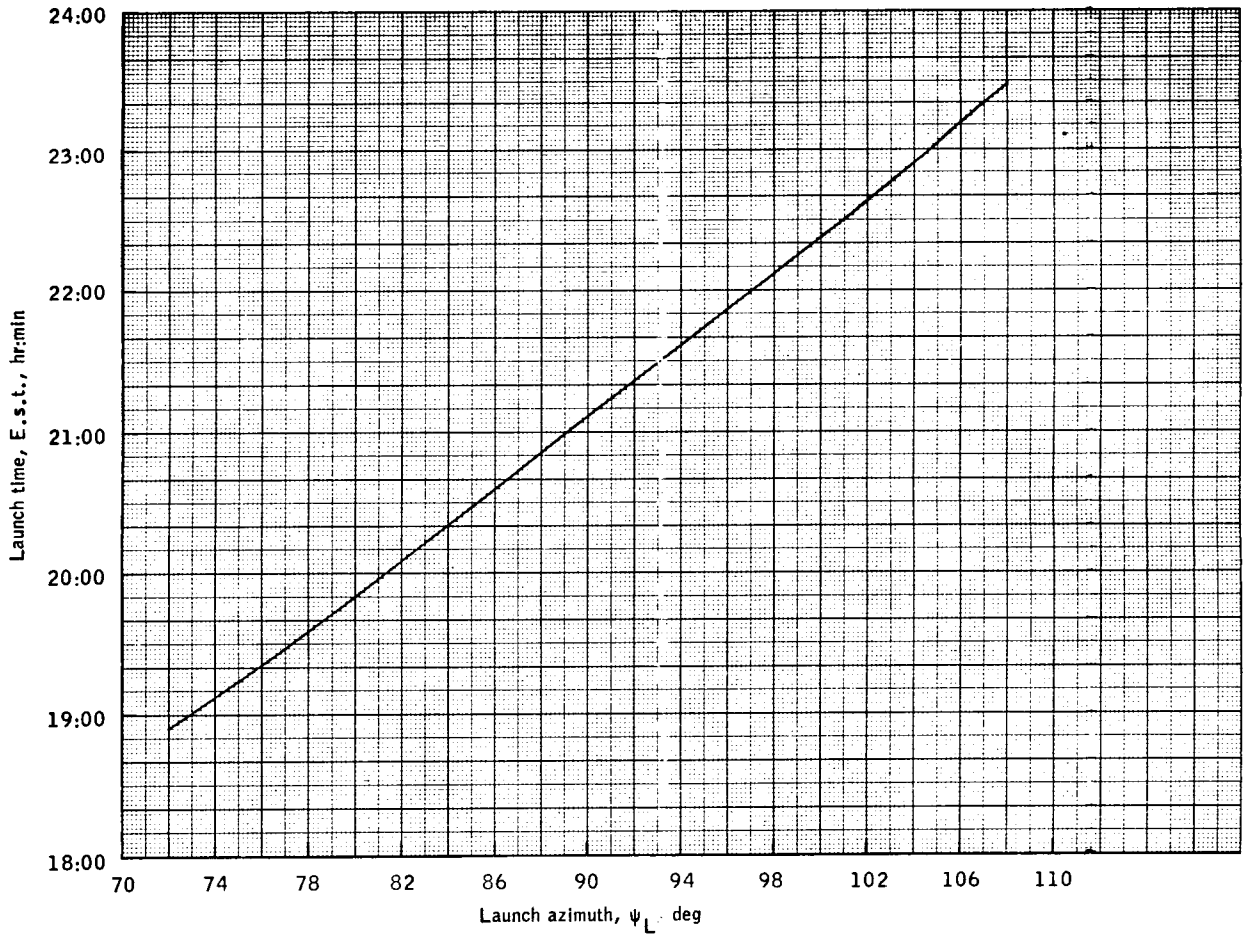
(l) February 11, 1968.

Figure 1. - Continued.



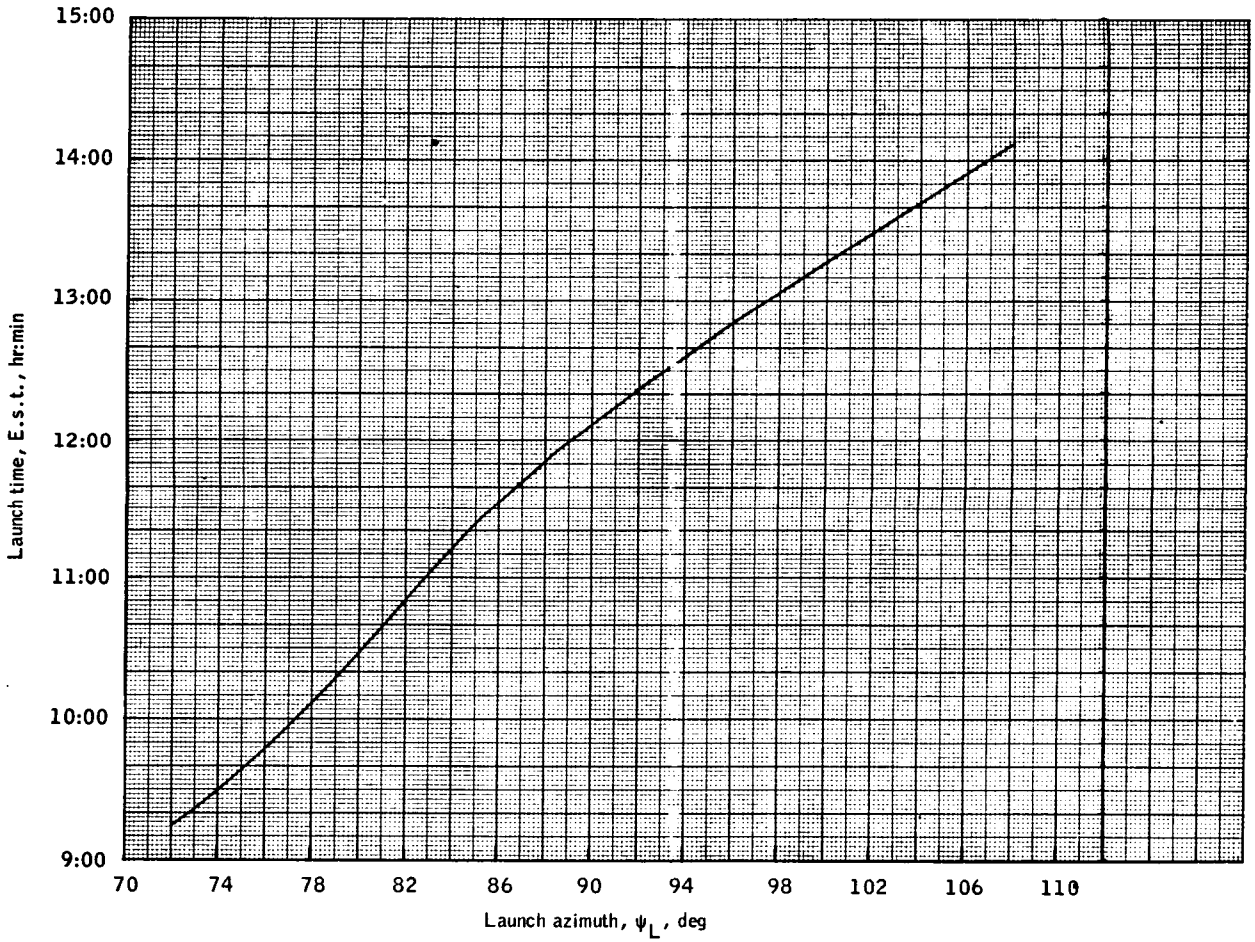
(m) February 12, 1968.

Figure 1. - Continued.



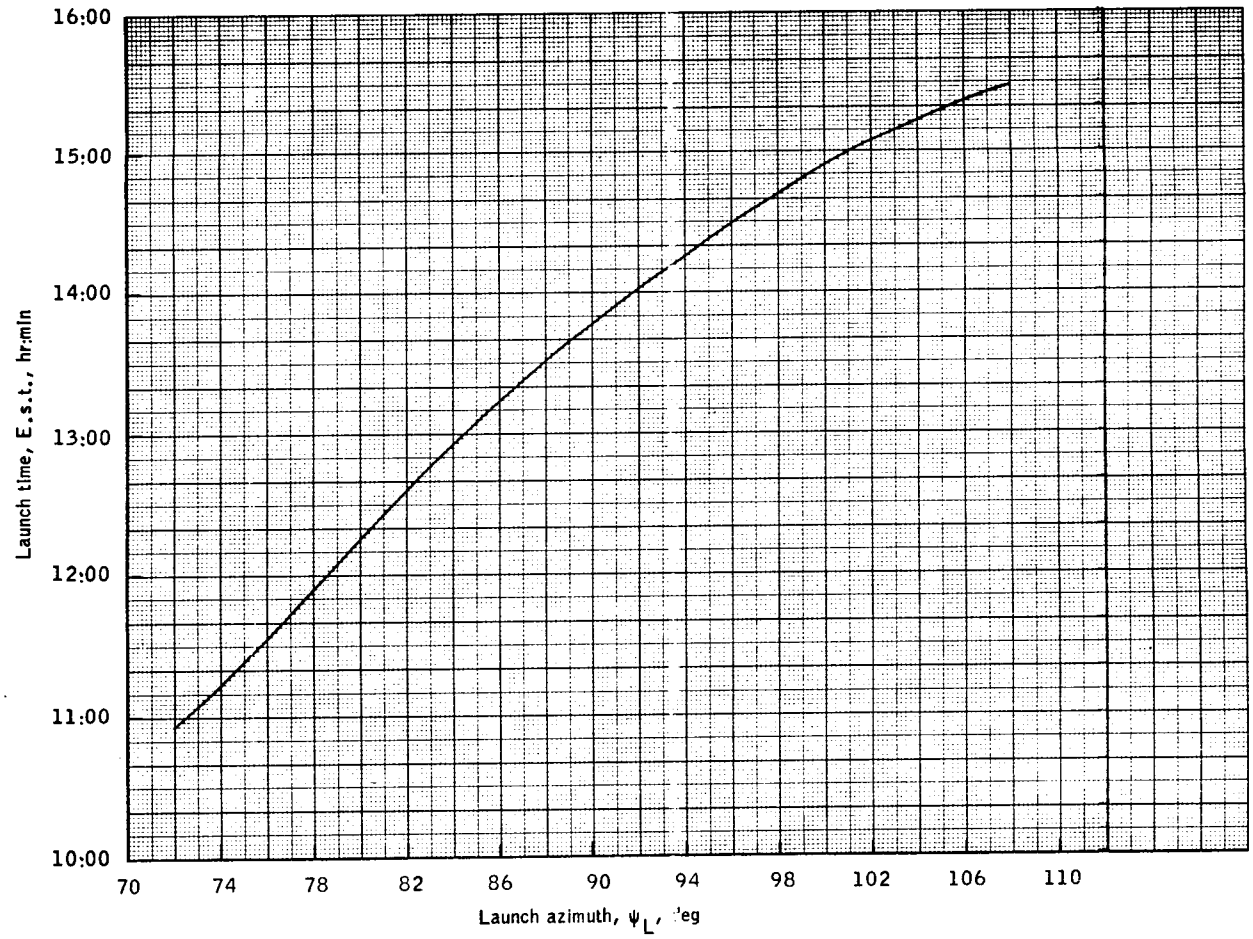
(n) February 13, 1968.

Figure 1.- Continued.



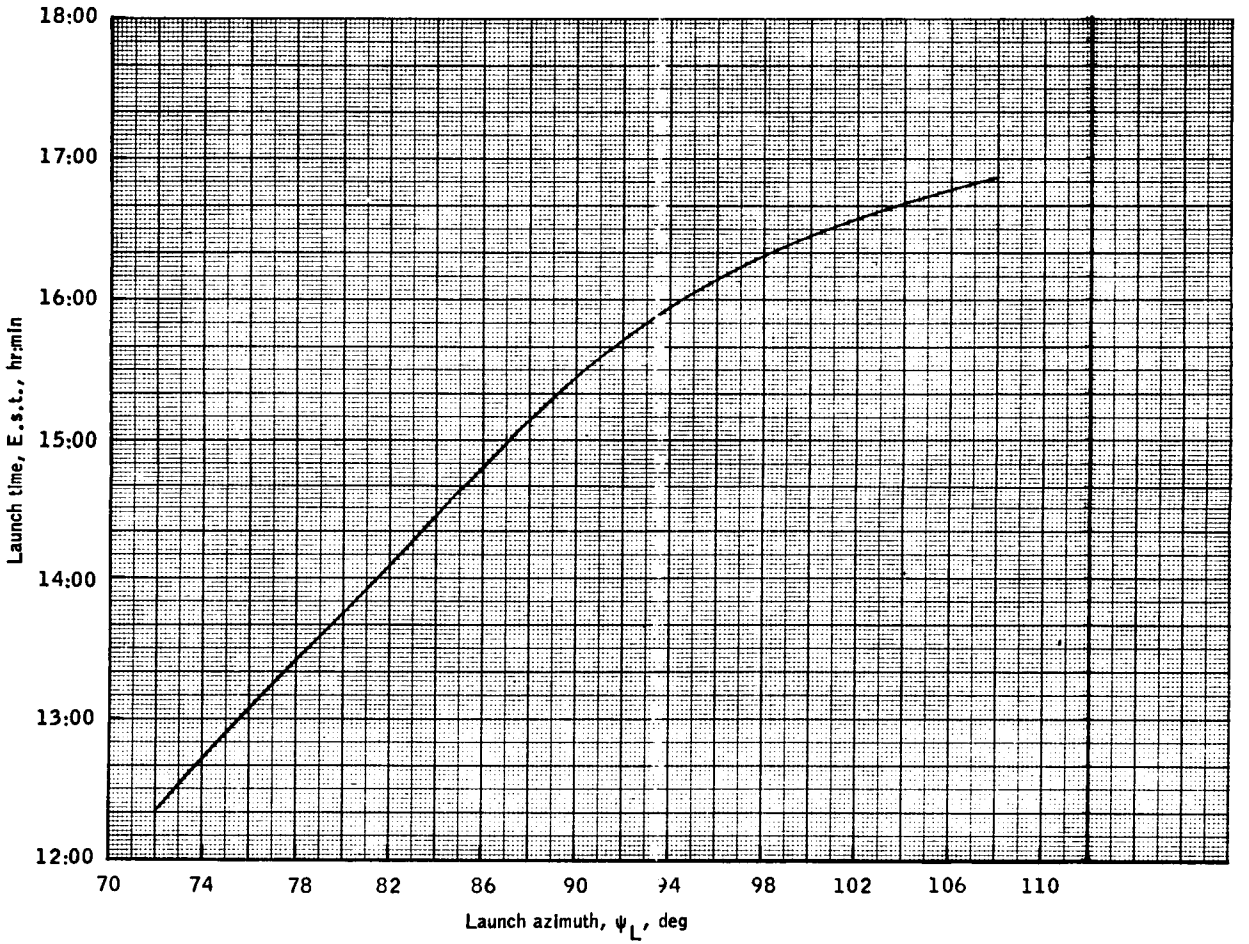
(o) February 29, 1968.

Figure 1.- Continued.



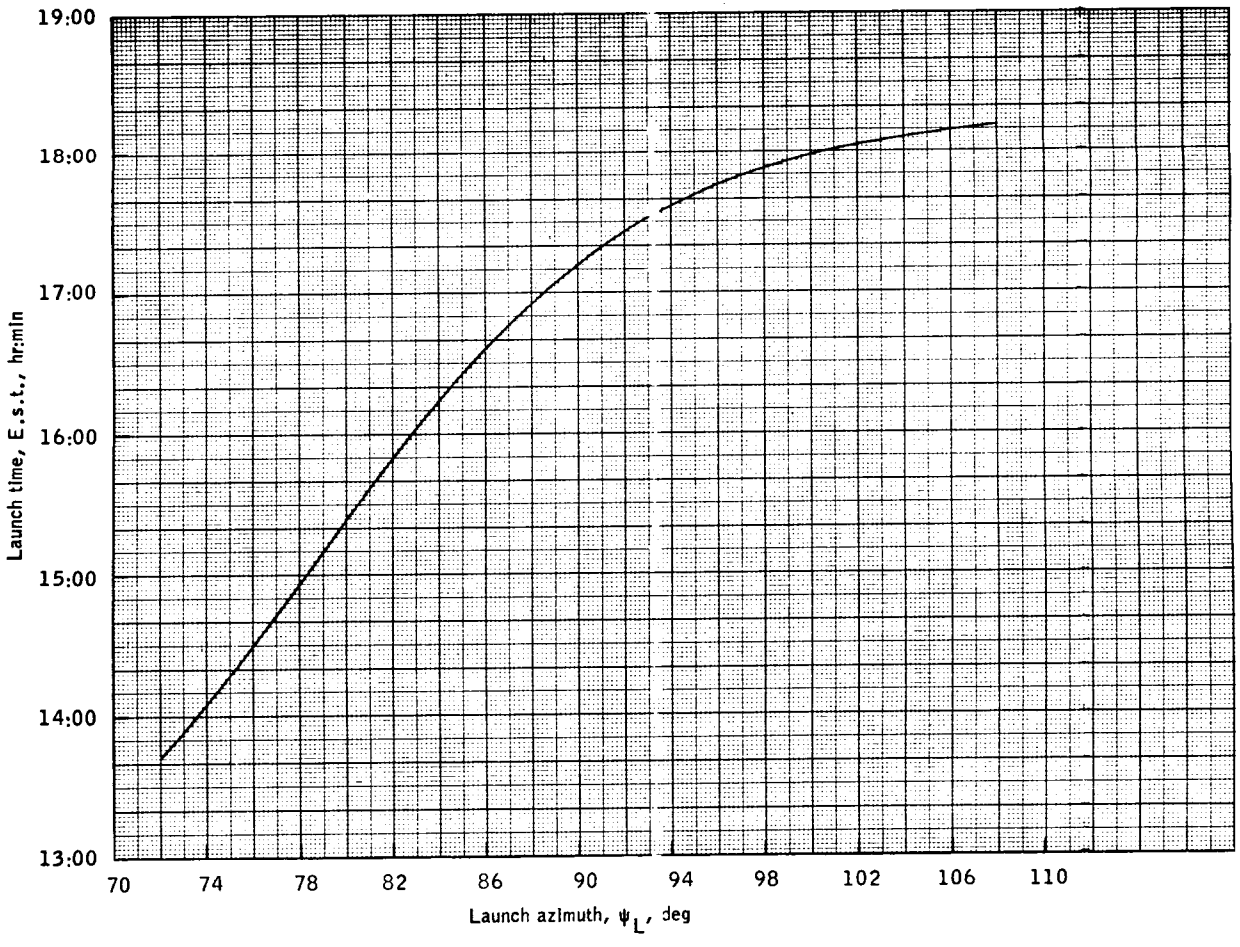
(p) March 1, 1968.

Figure 1.- Continued.



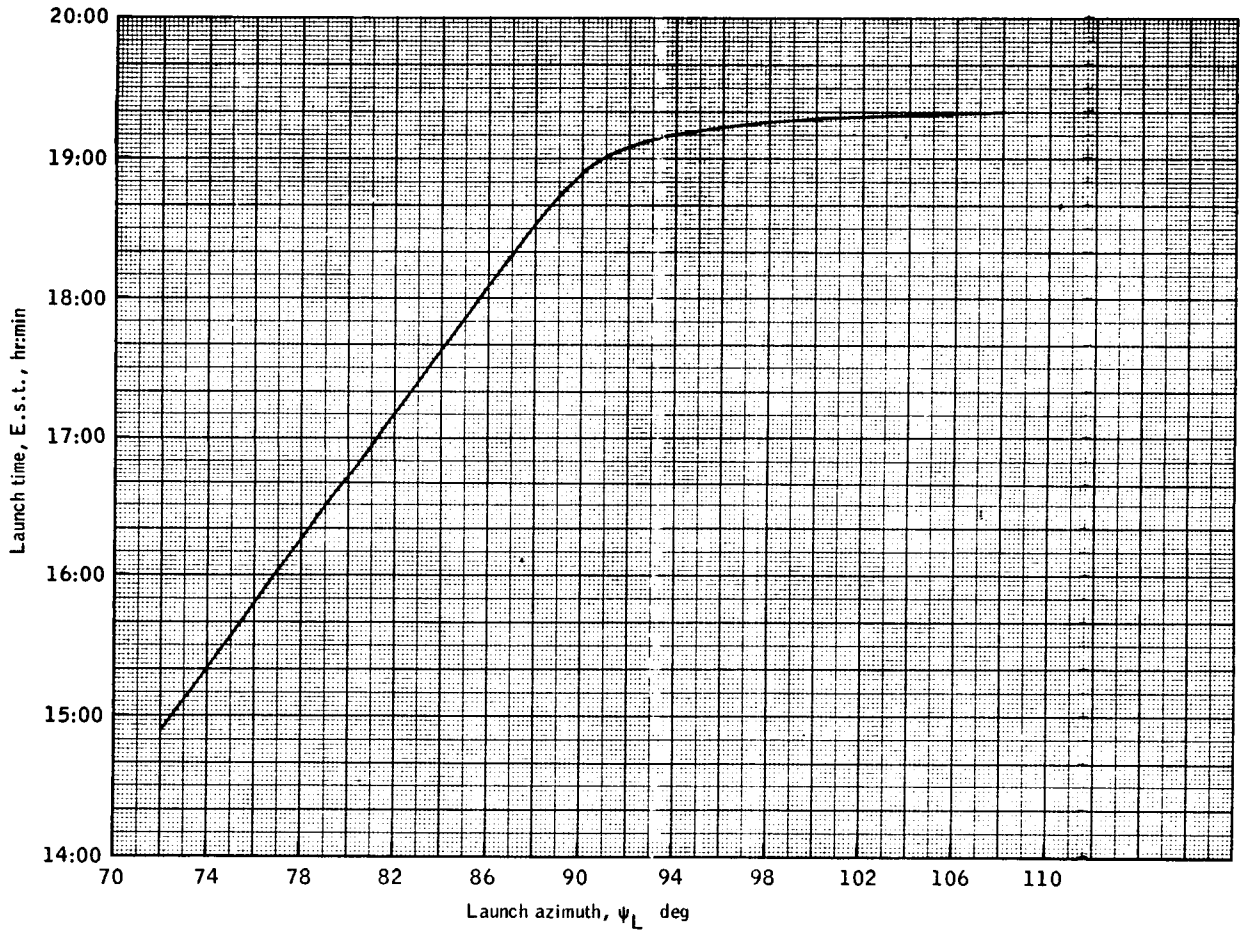
(q) March 2, 1968.

Figure 1. - Continued.



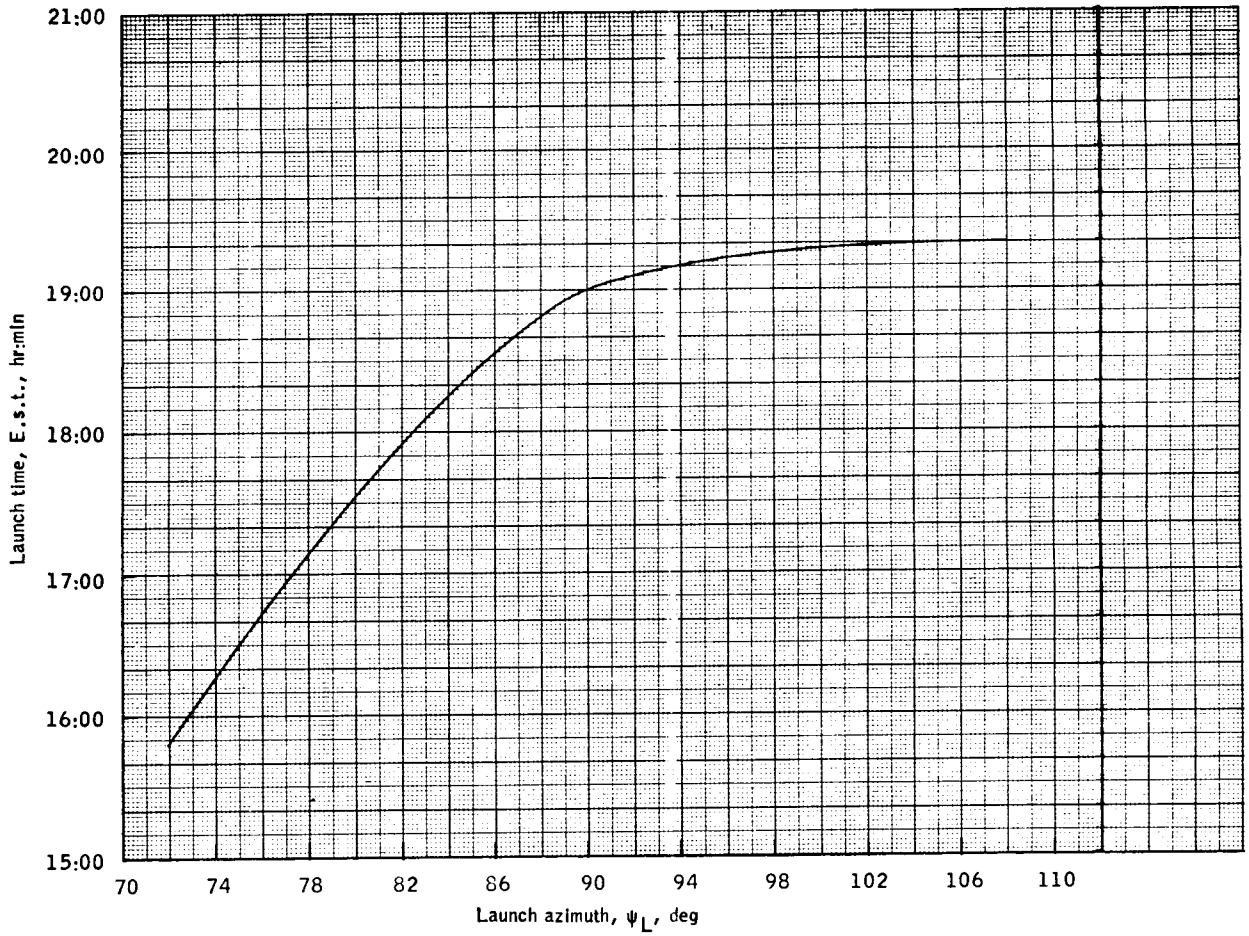
(r) March 3, 1968.

Figure 1.- Continued.



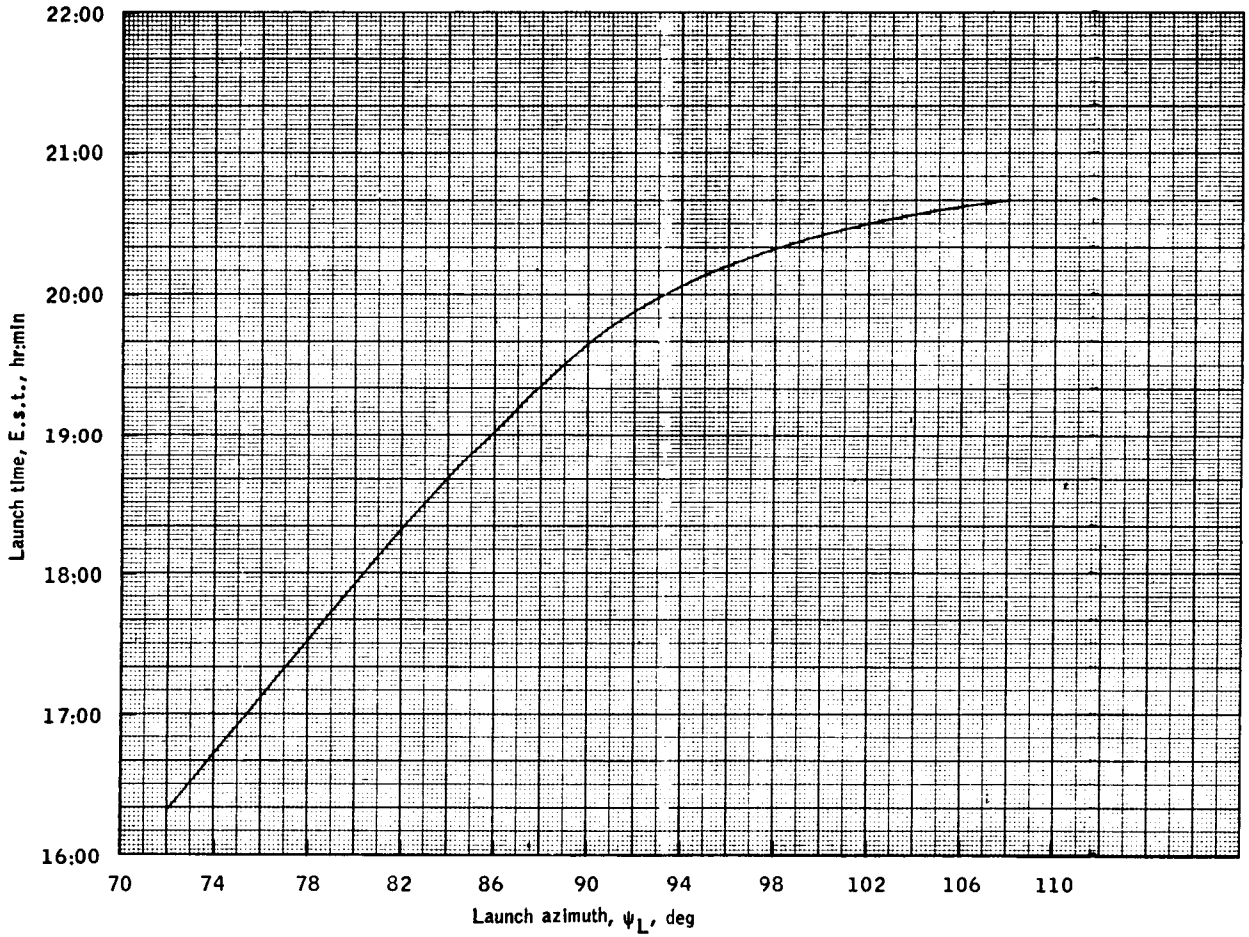
(s) March 4, 1960.

Figure 1.- Continued.



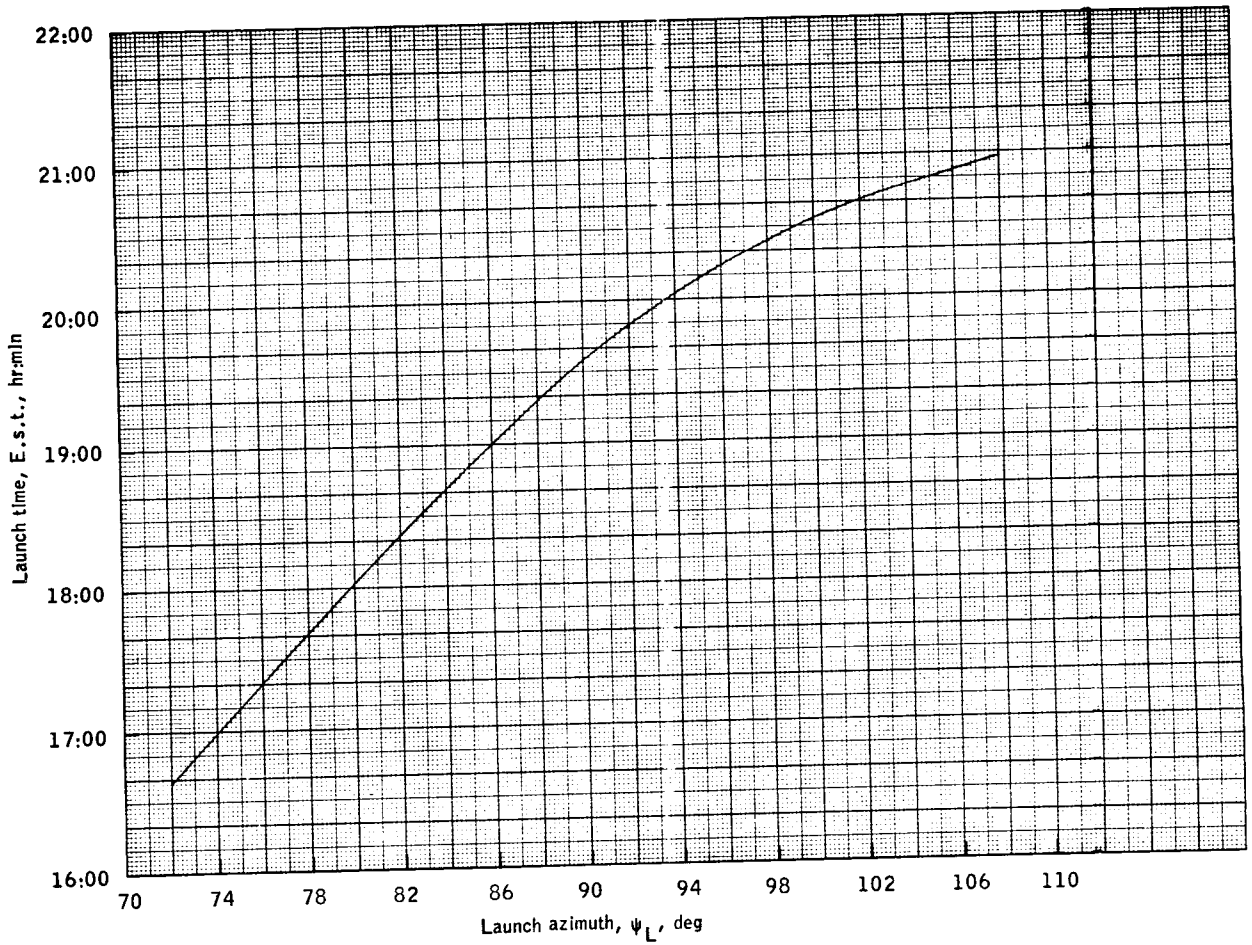
(t) March 5, 1960.

Figure 1.- Continued.



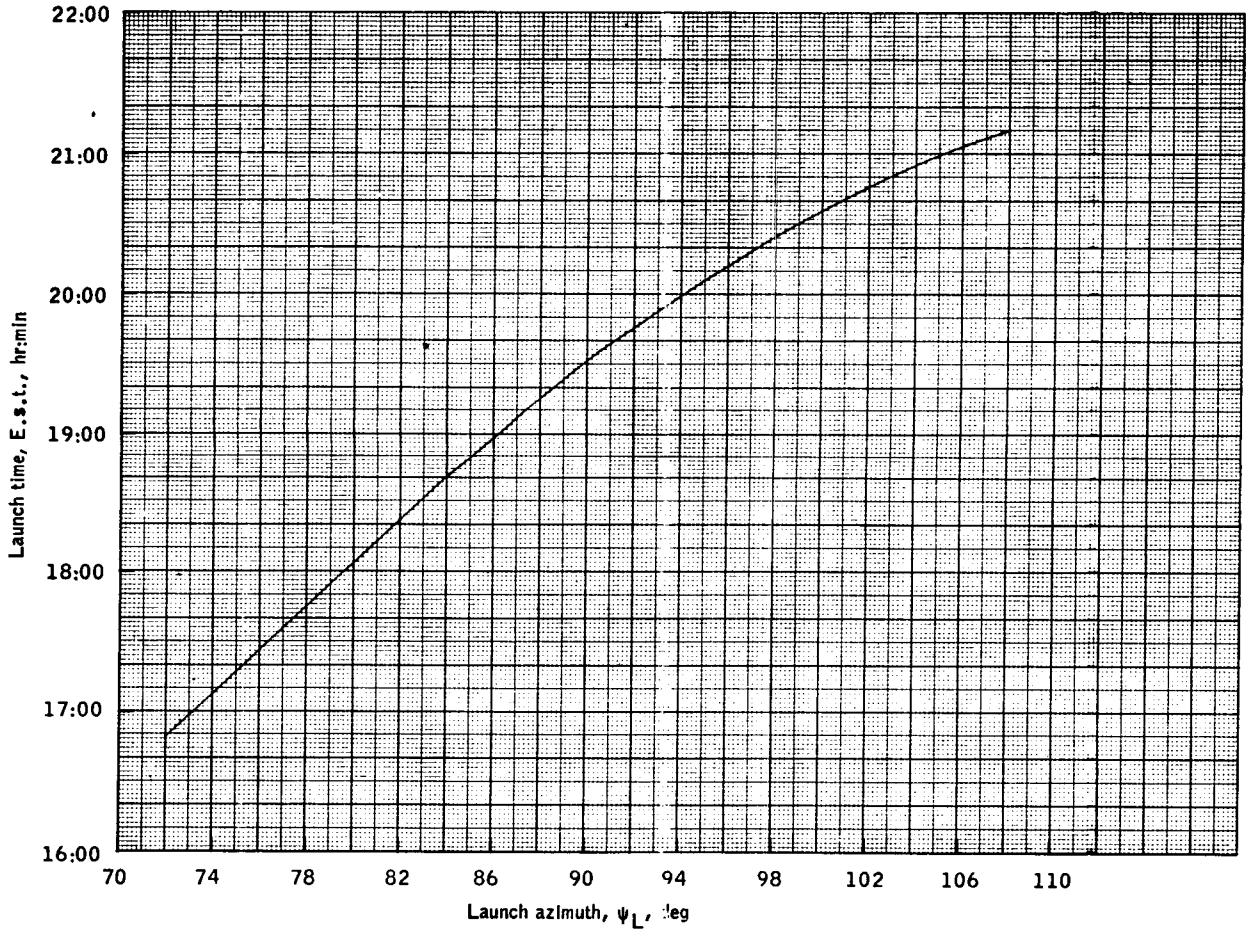
(u) March 6, 1968.

Figure 1.- Continued.



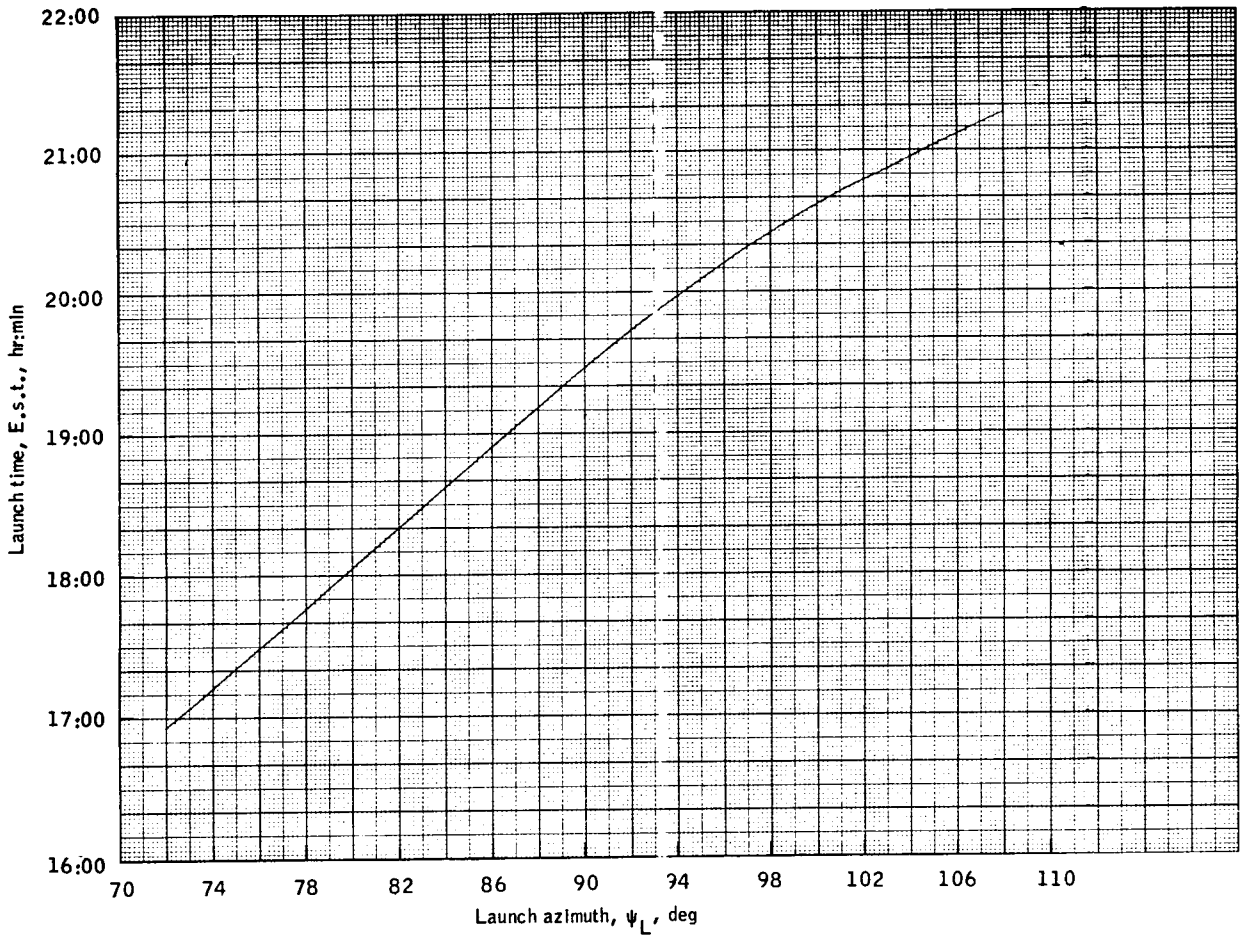
(v) March 7, 1968.

Figure 1.- Continued.



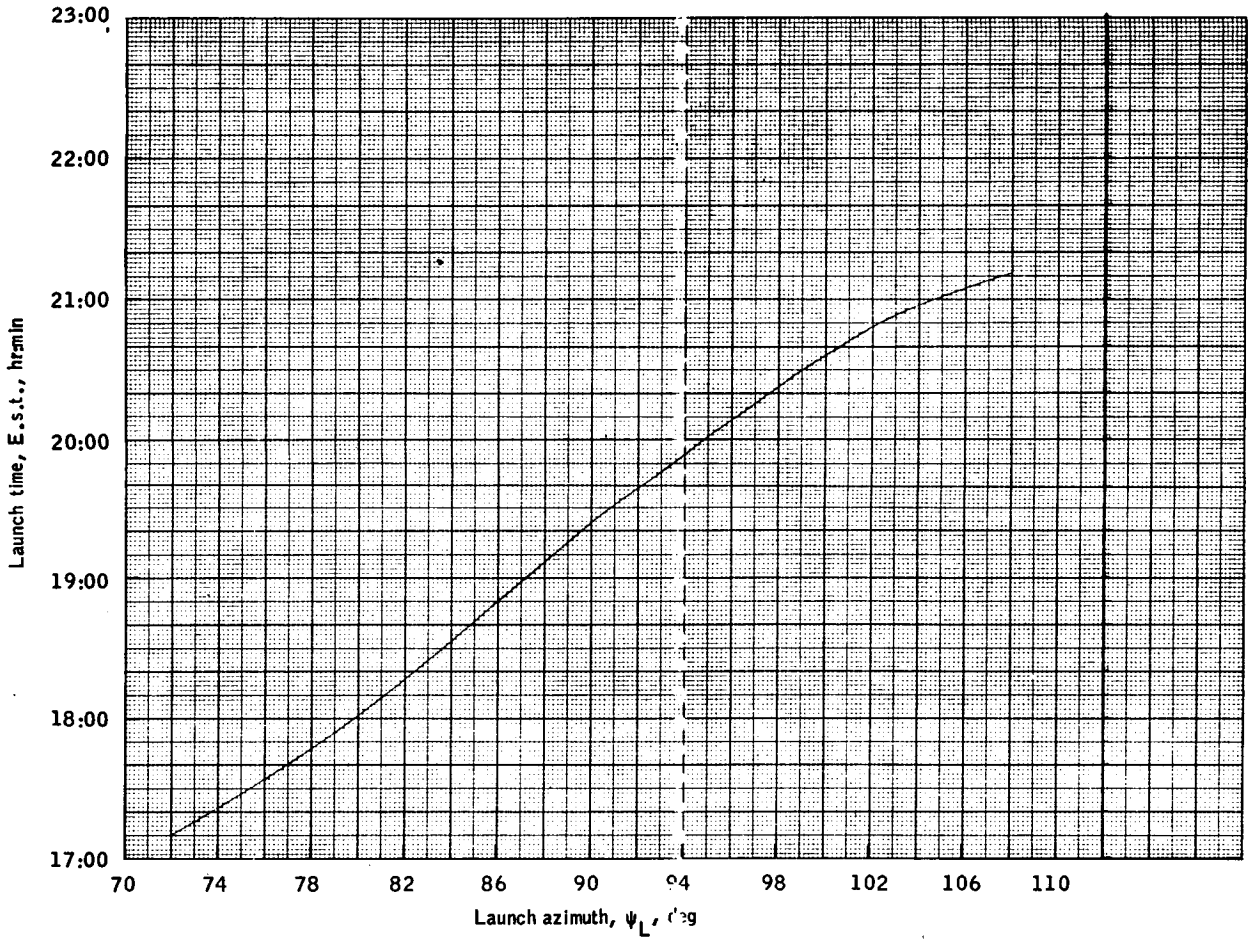
(w) March 8, 1968.

Figure 1.- Continued.



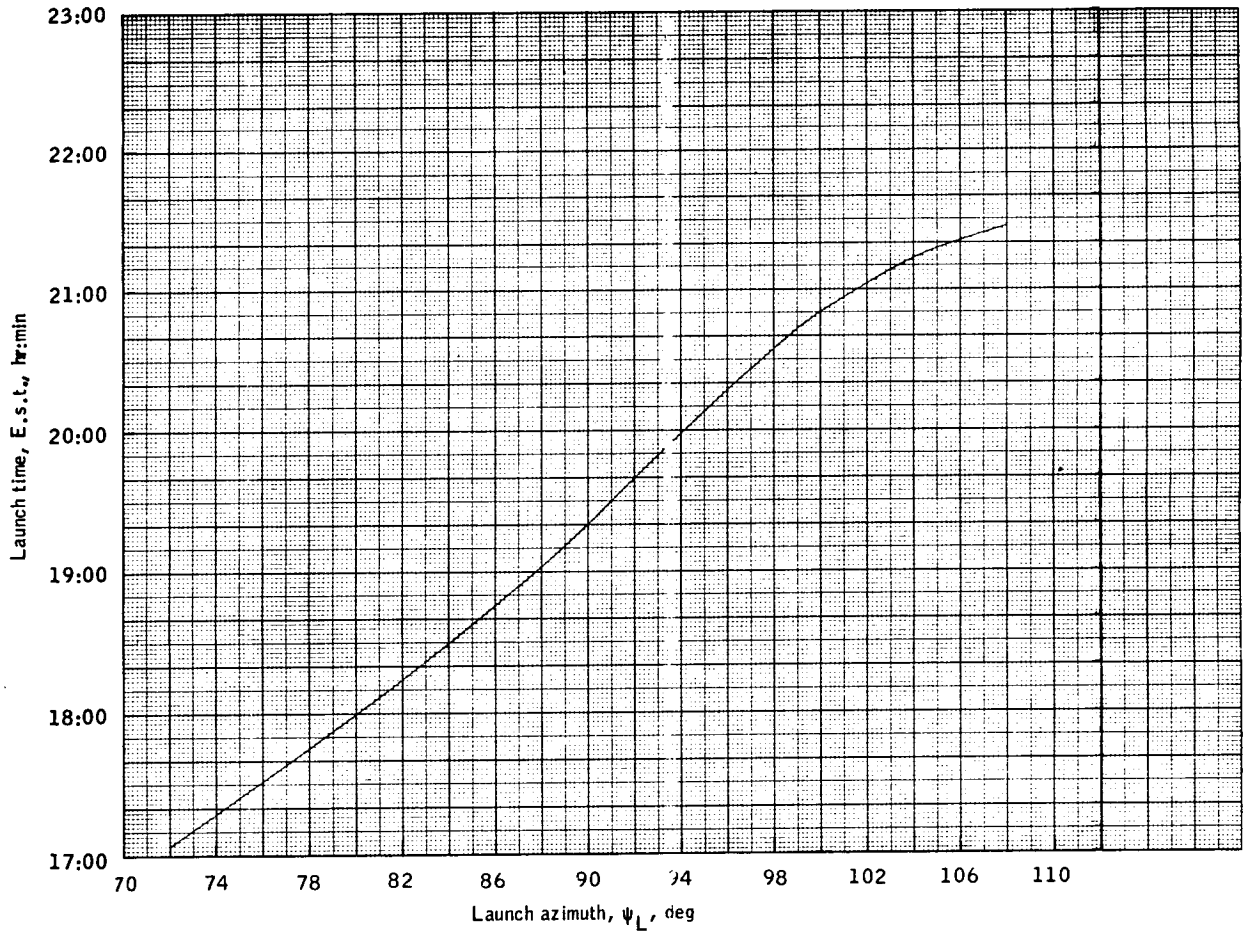
(x) March 9, 1968

Figure 1.- Continued.



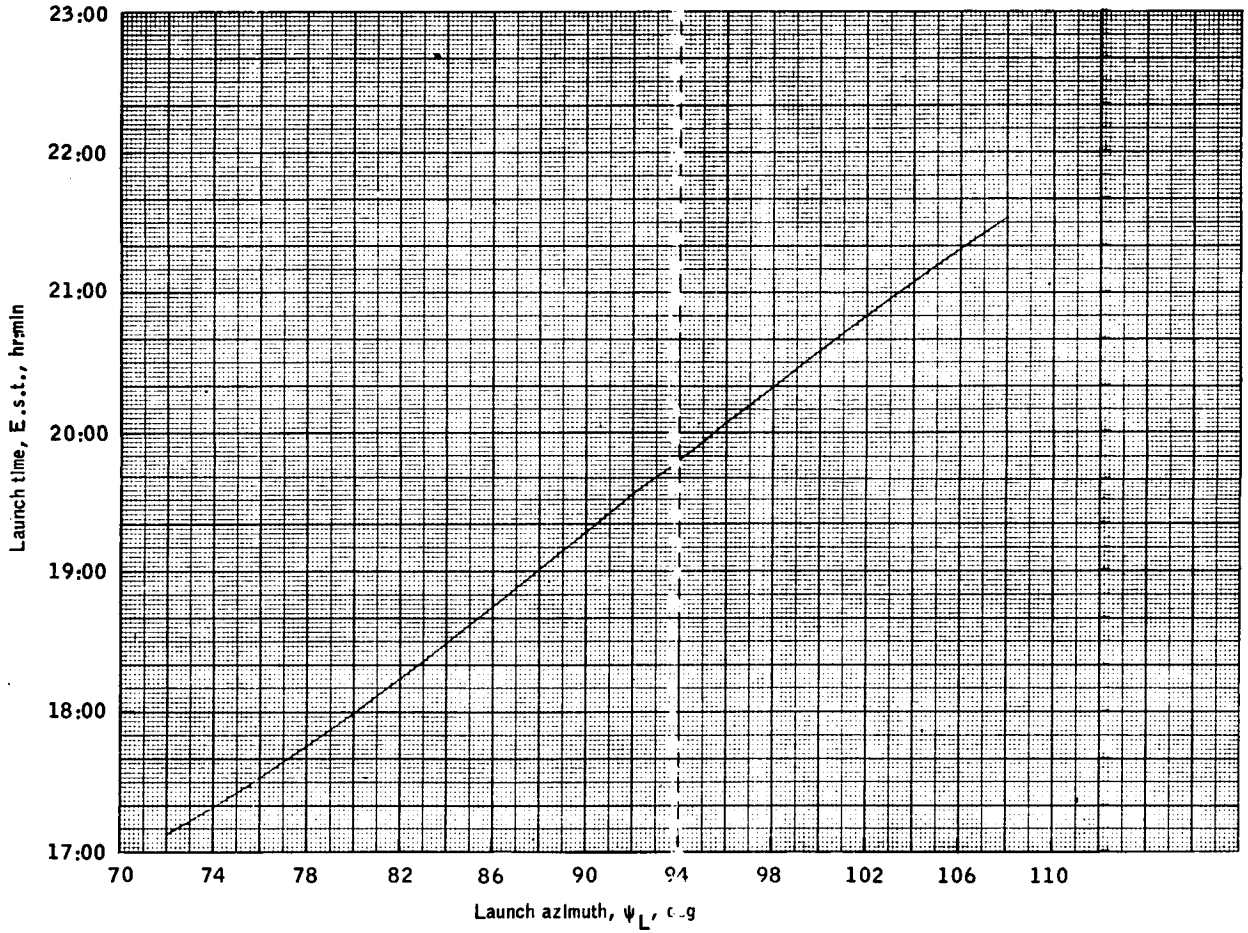
(y) March 10, 1968.

Figure 1.- Continued



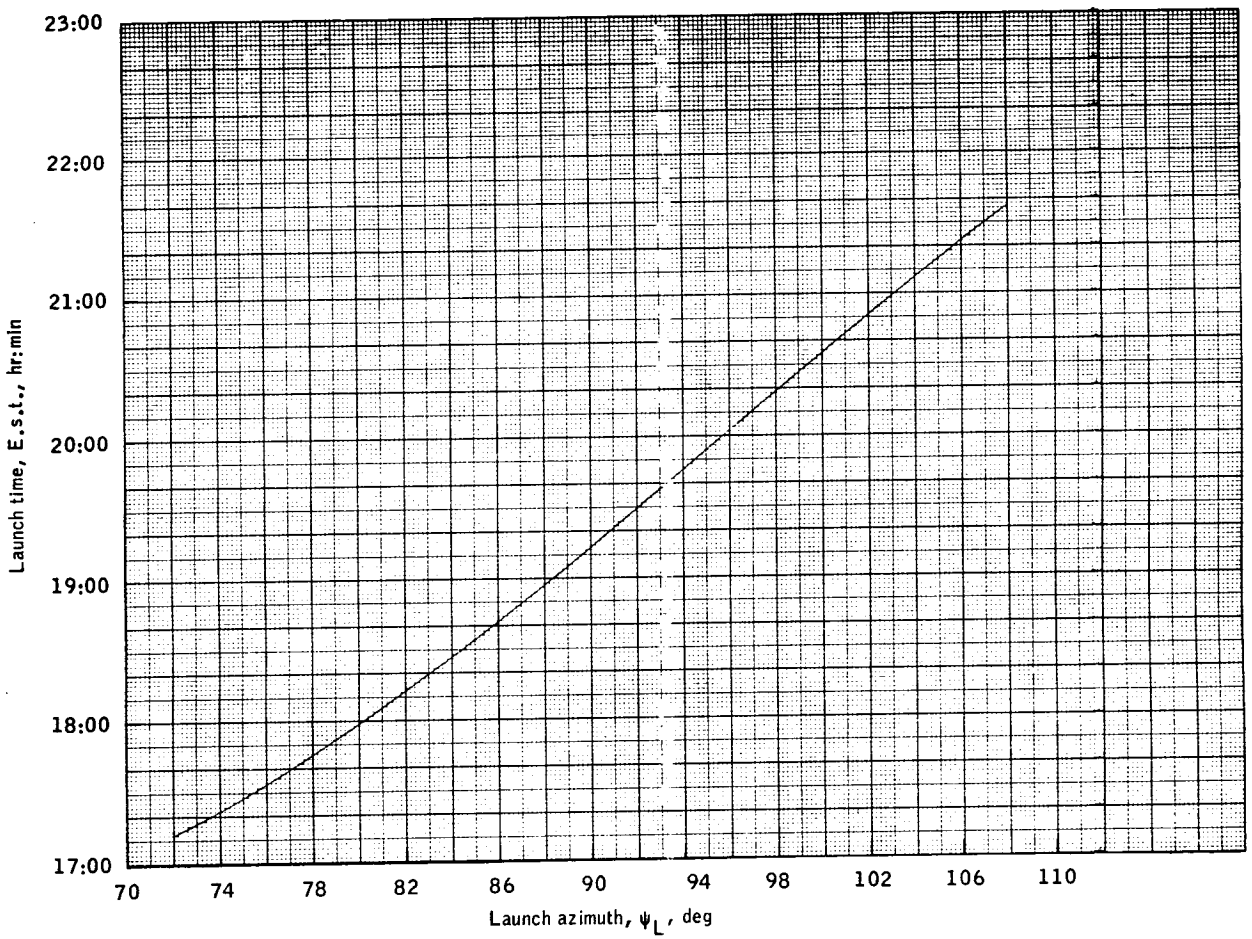
(z) March 11, 1960.

Figure 1.- Continued.



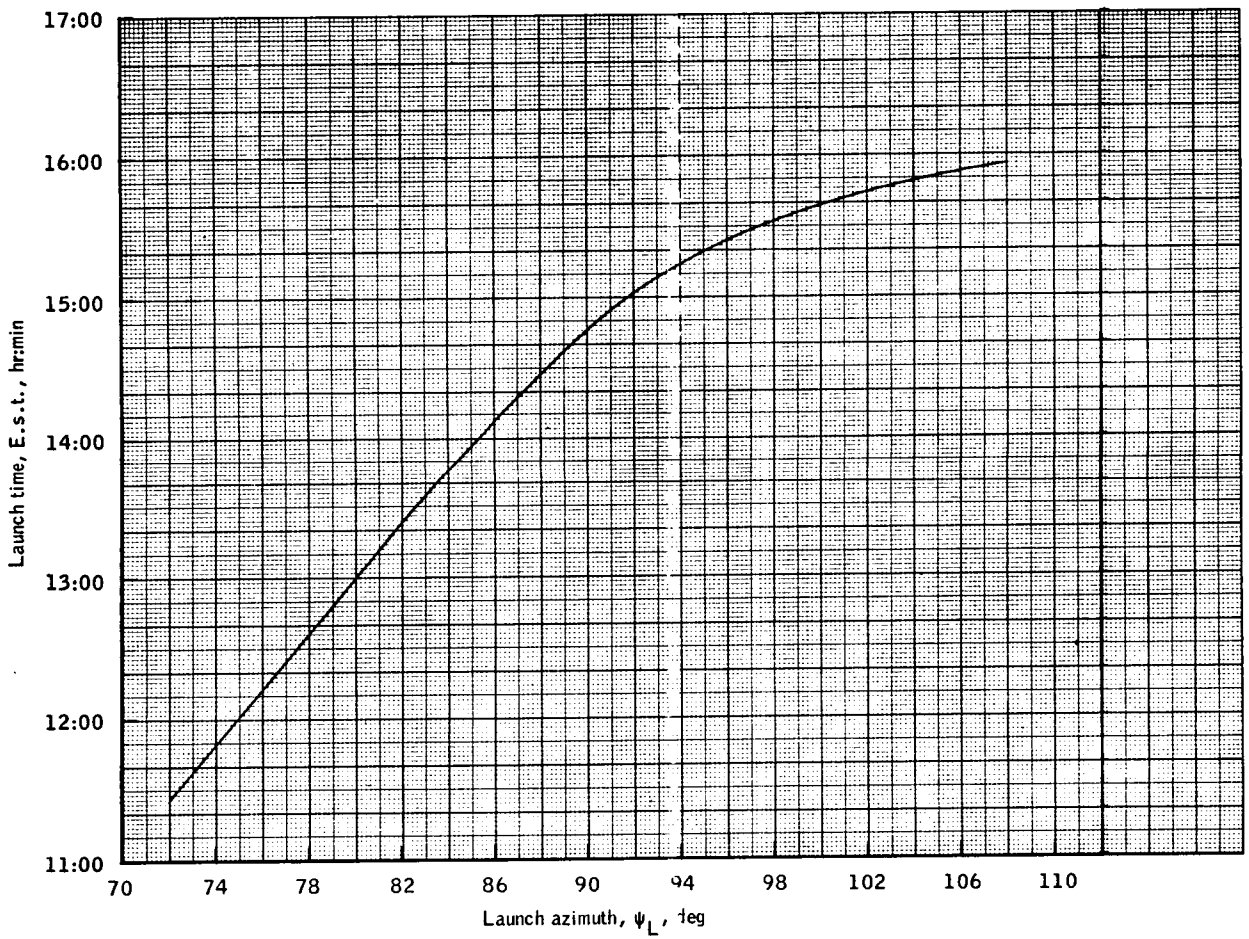
(aa) March 12, 1968.

Figure 1.- Continued.



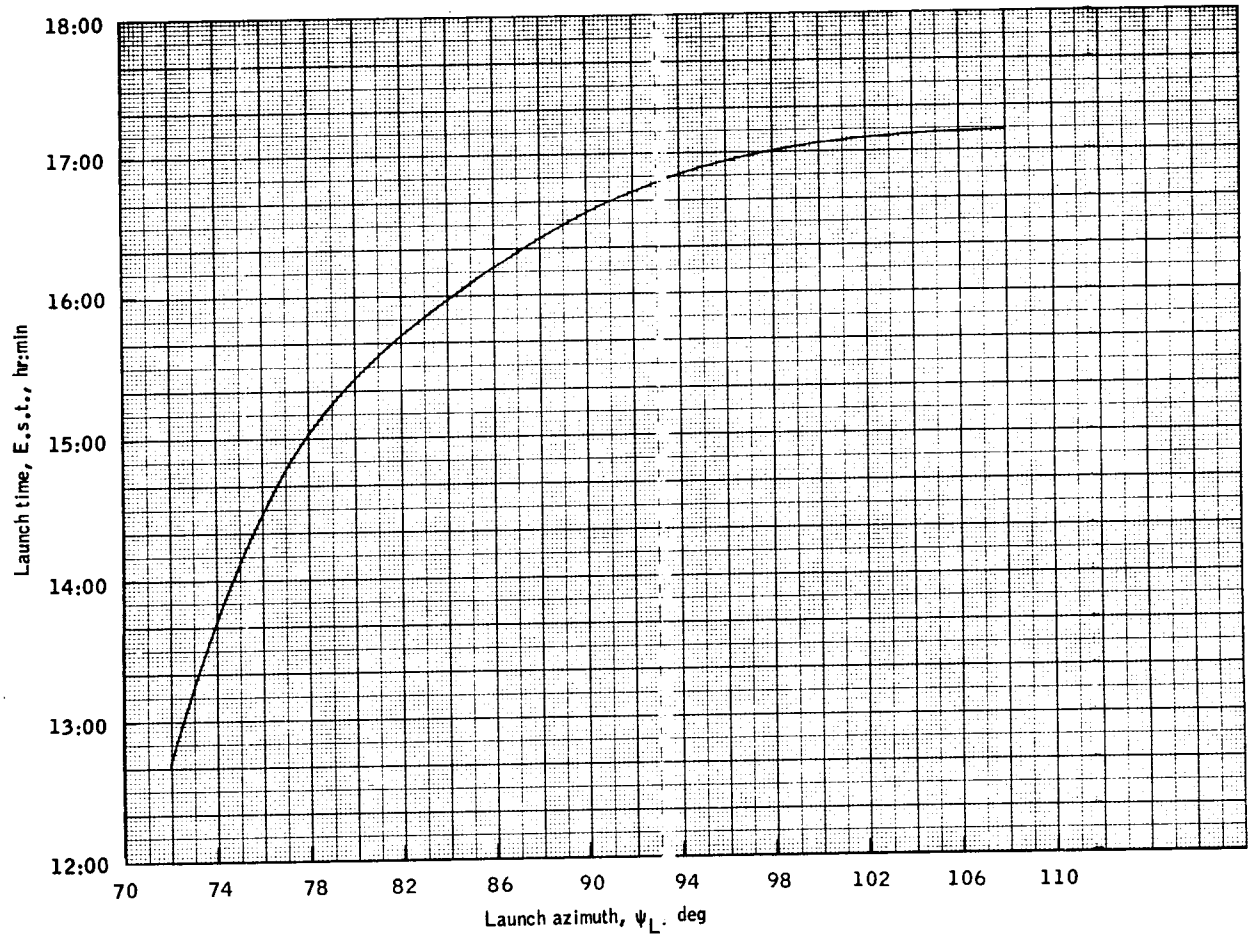
(bb) March 13, 1968.

Figure 1.- Continued.



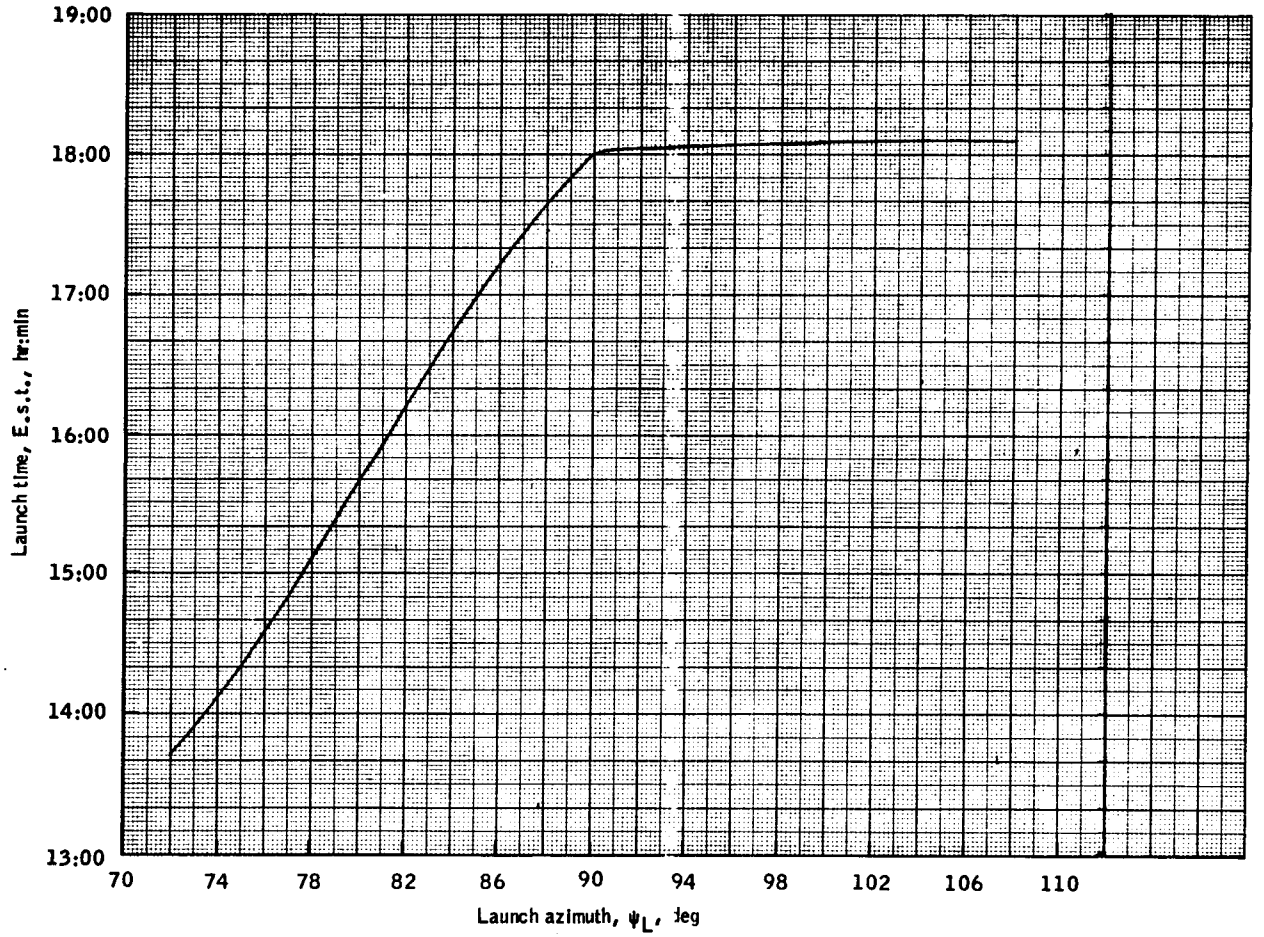
(cc) March 30, 1963.

Figure 1.- Continued.



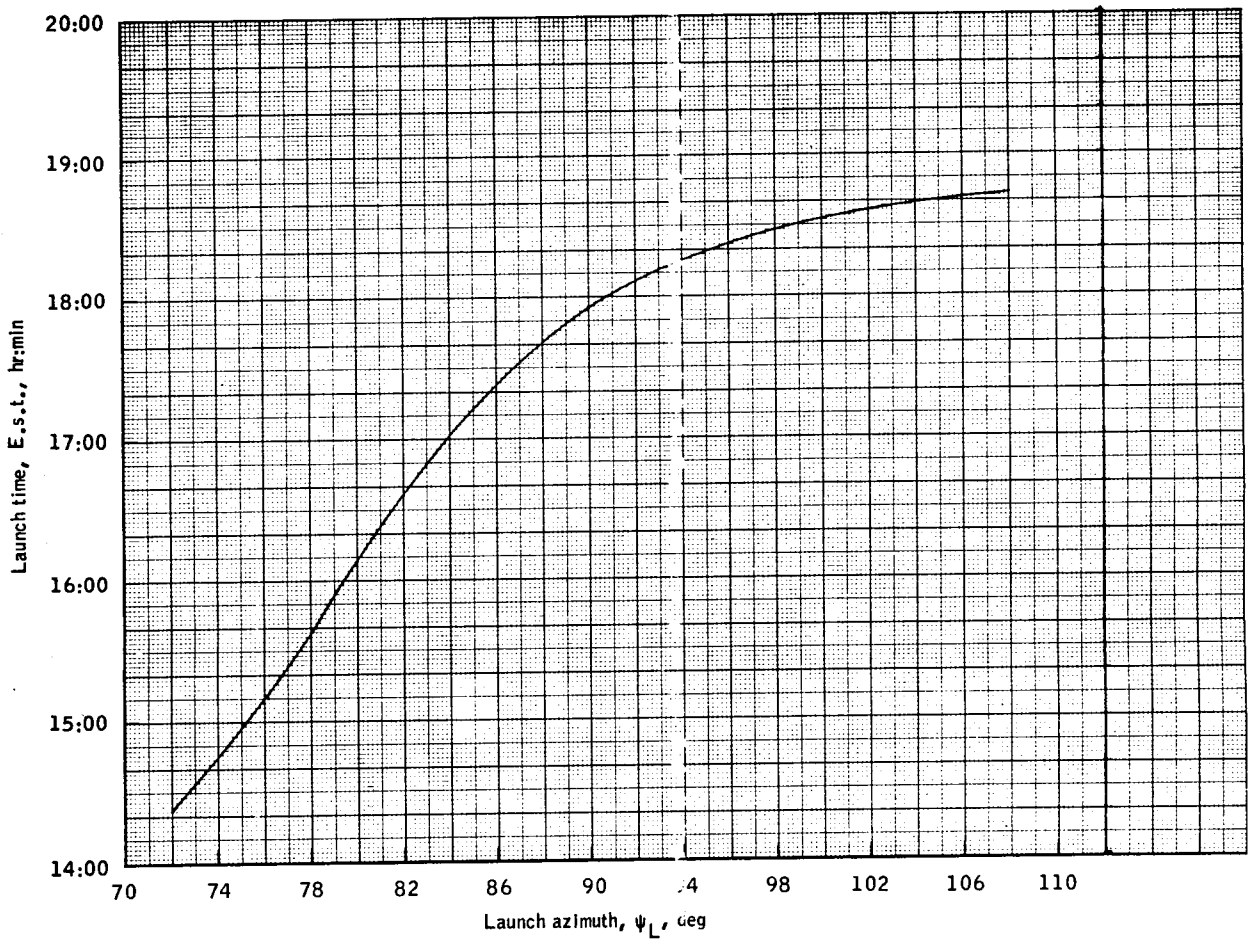
(dd) March 31, 1968.

Figure 1.- Continued.



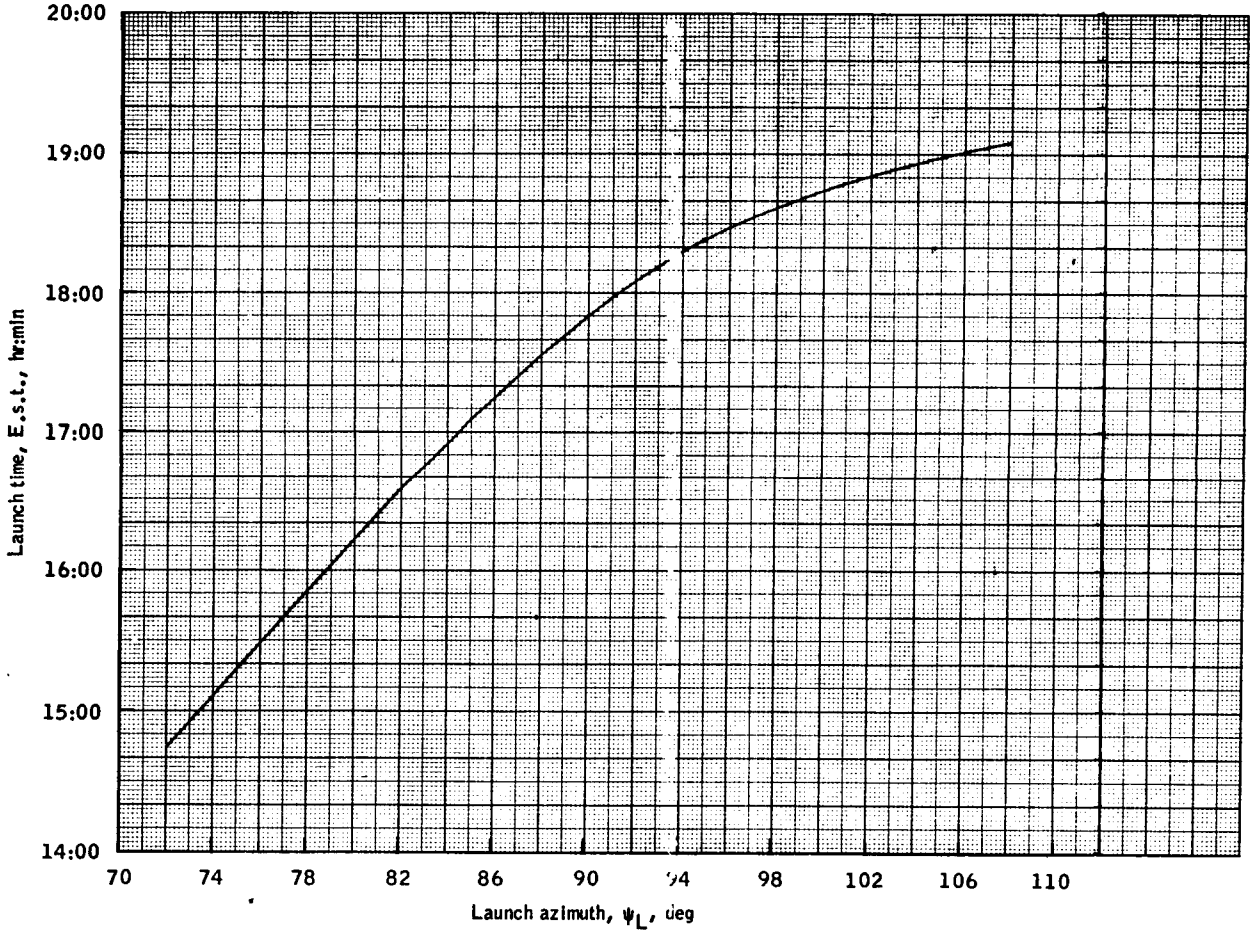
(ee) April 1, 1968.

Figure 1.- Continued.



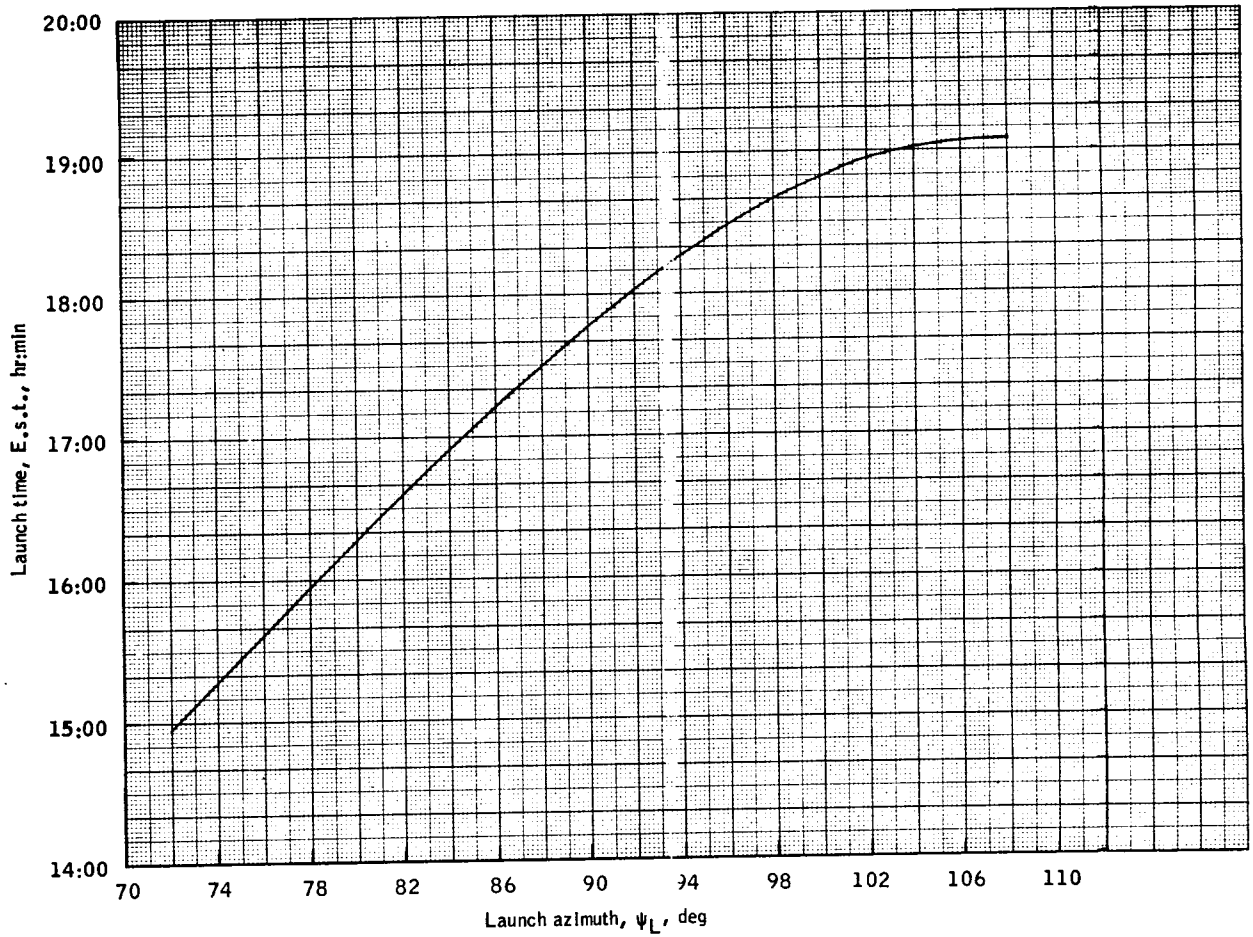
(ff) April 2, 1968

Figure 1.- Continued.



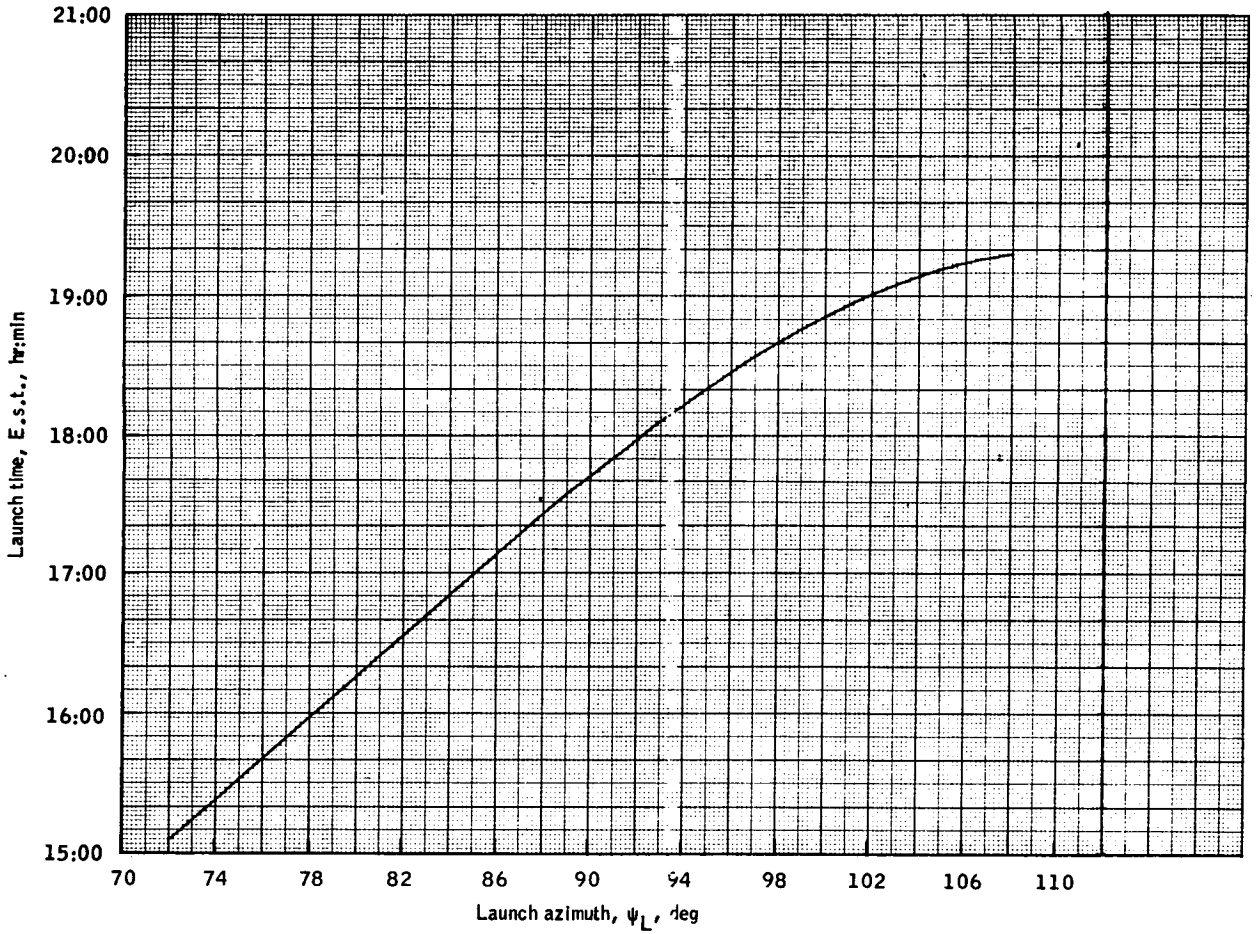
(gg) April 3, 1968.

Figure 1.- Continued.



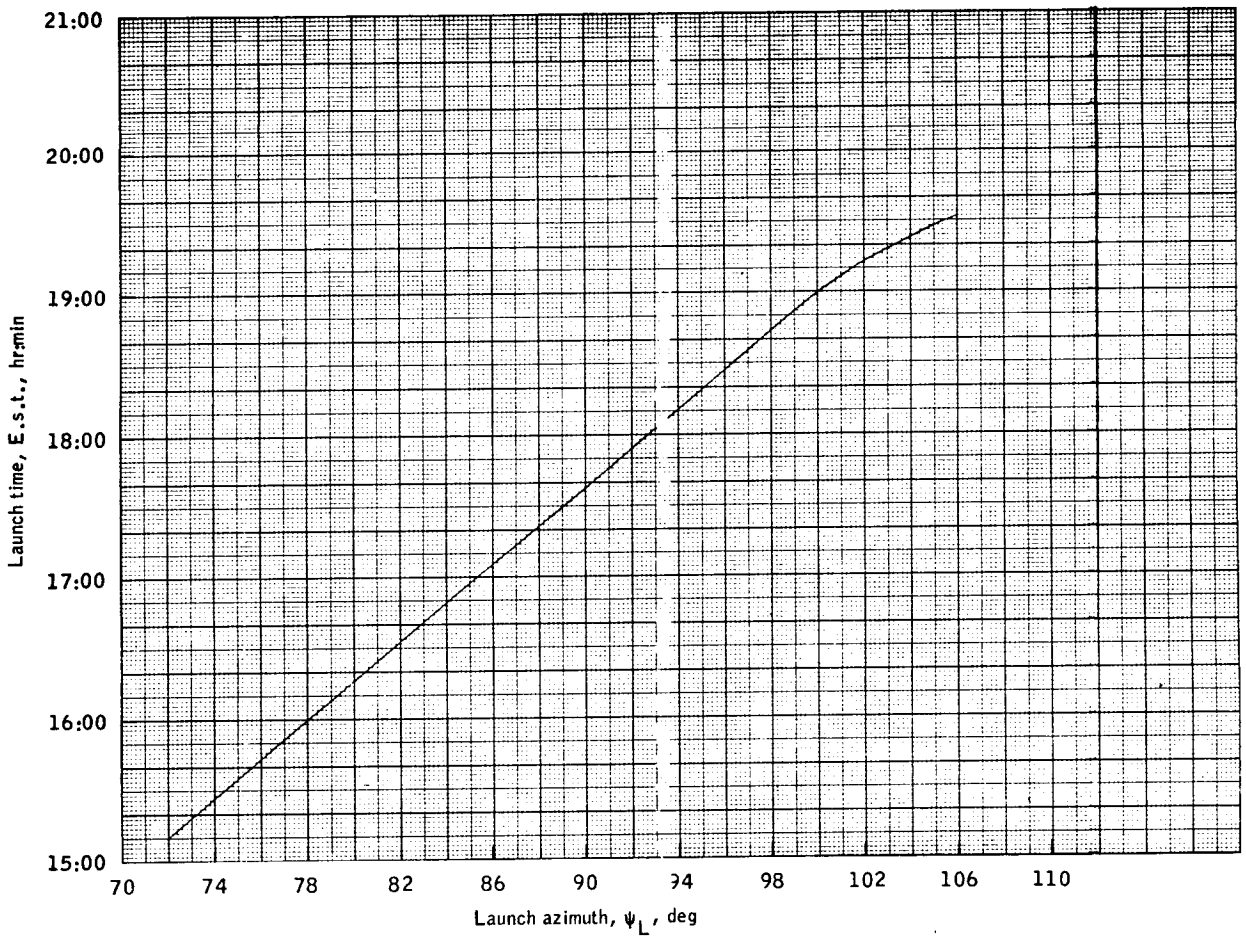
(hh) April 4, 1968.

Figure 1.- Continued.



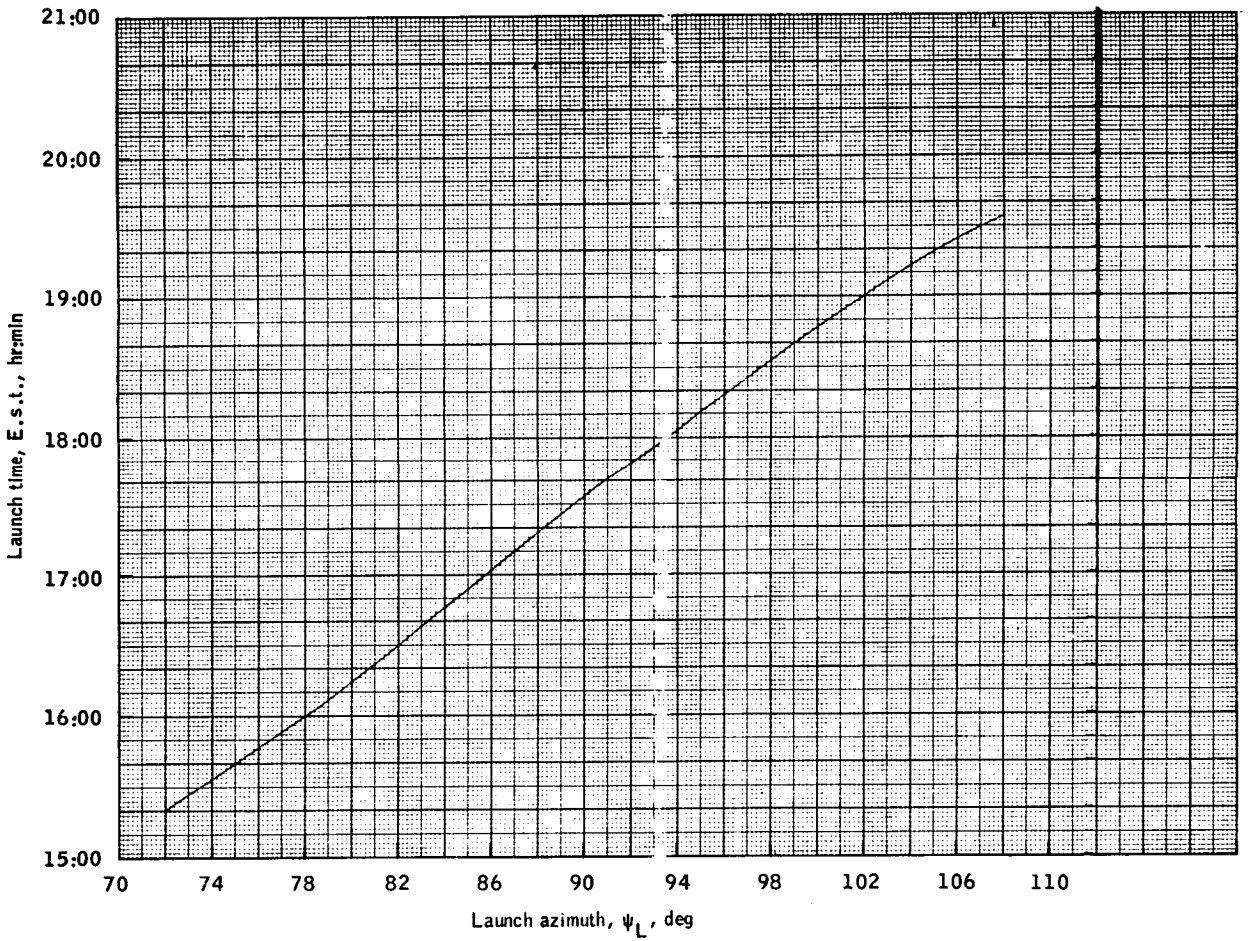
(ii) April 5, 1968.

Figure 1.- Continued.



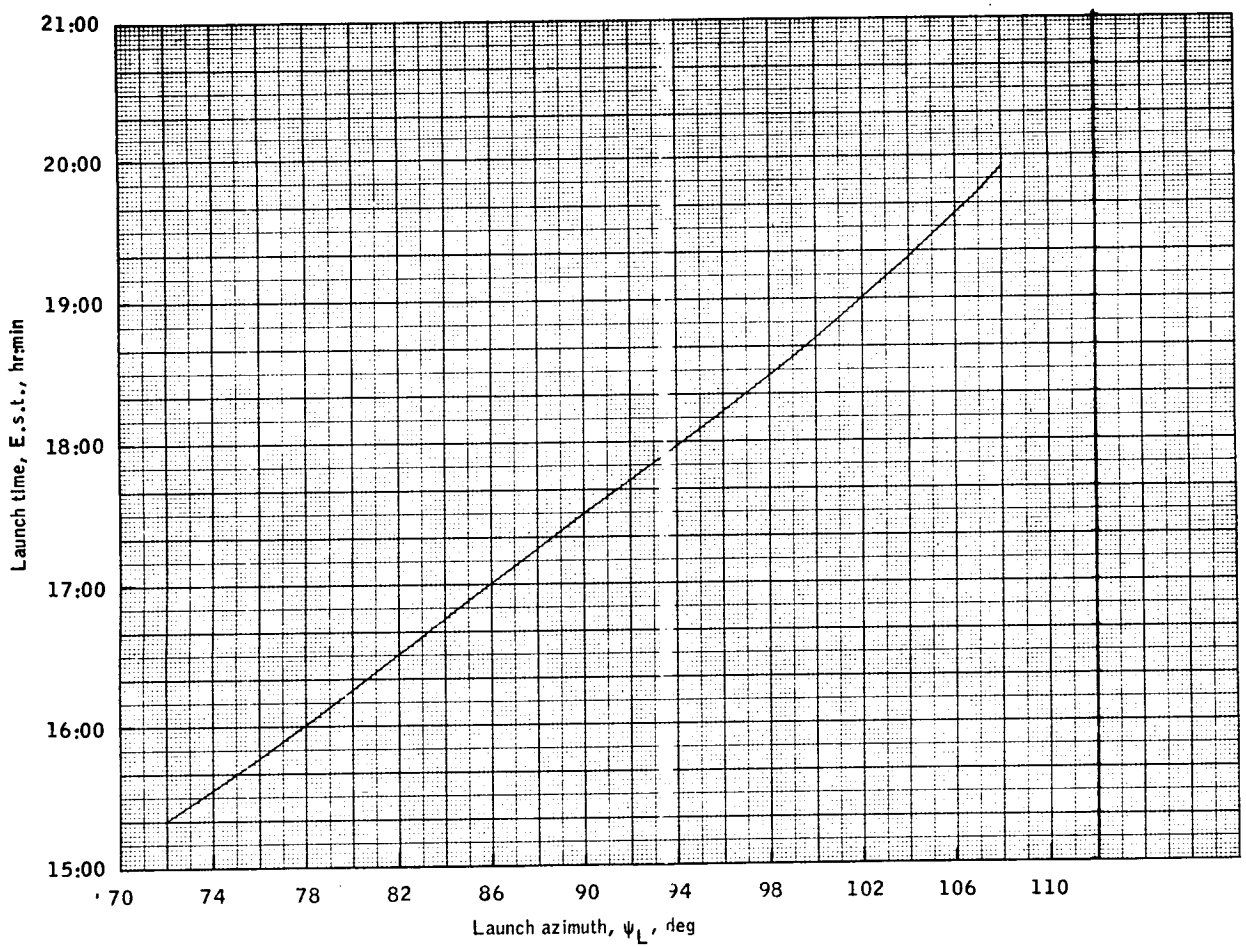
(jj) April 6, 1968.

Figure 1.- Continued.



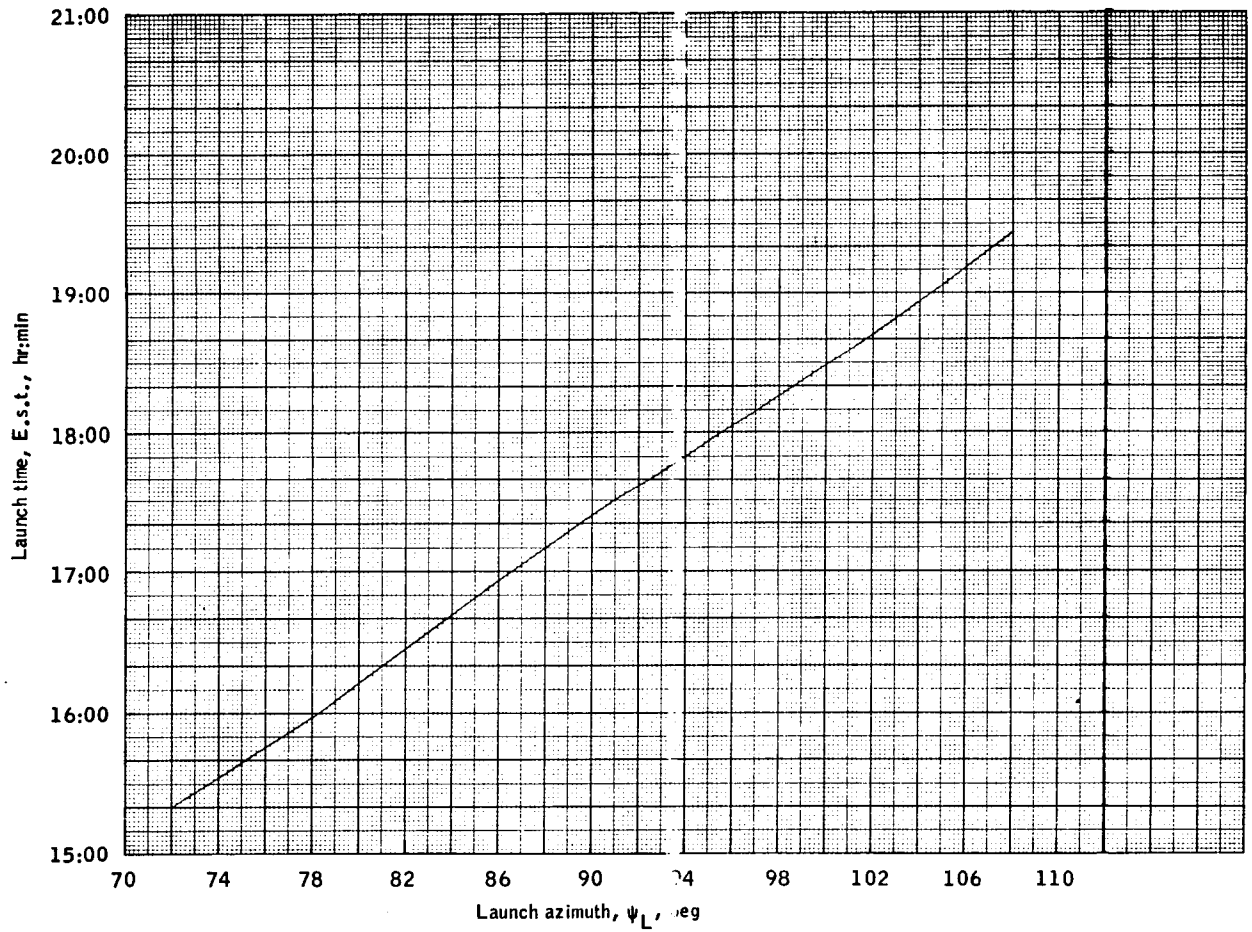
(kk) April 7, 196^.

Figure 1.- Continued.



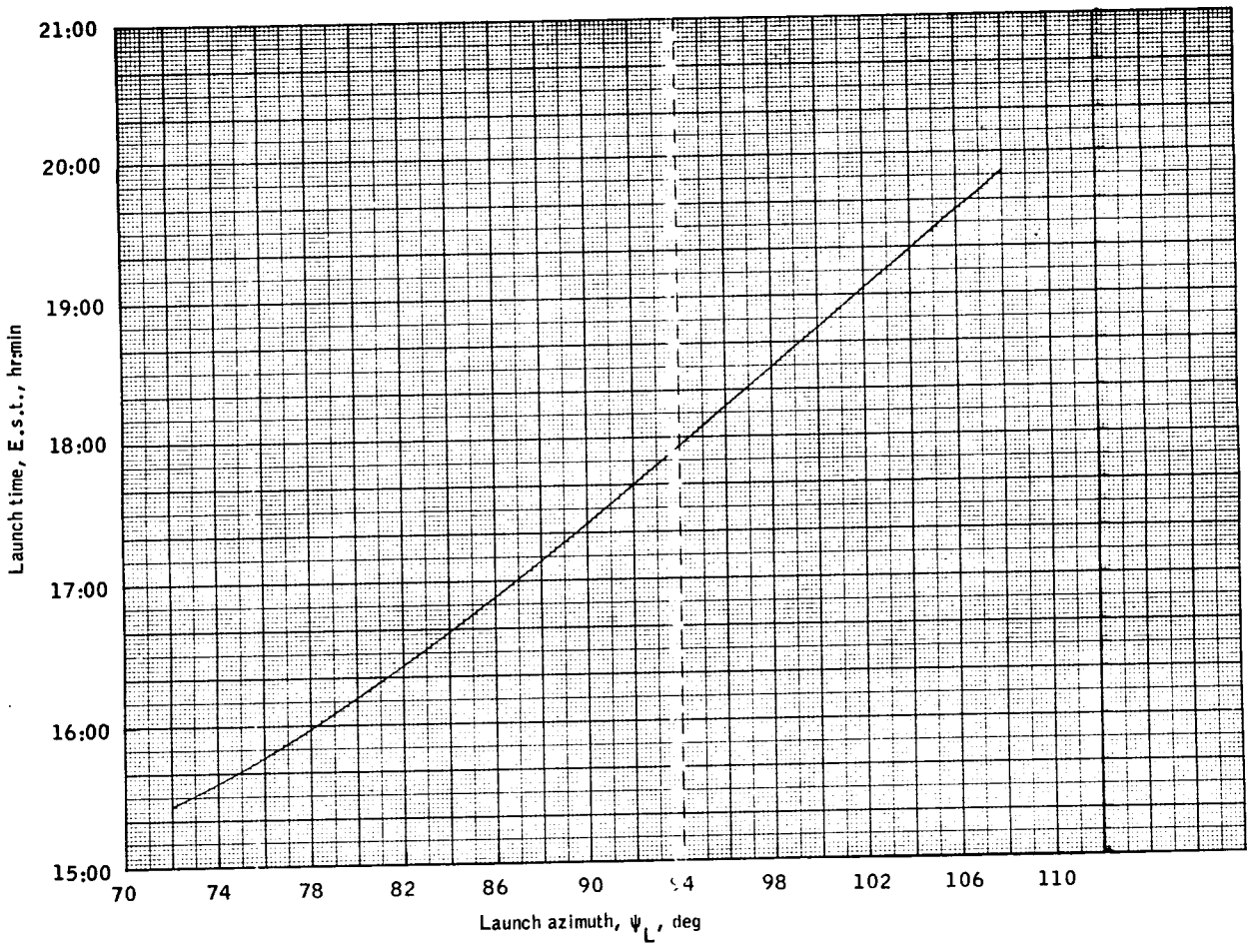
(II) April 8, 1968.

Figure 1.- Continued.



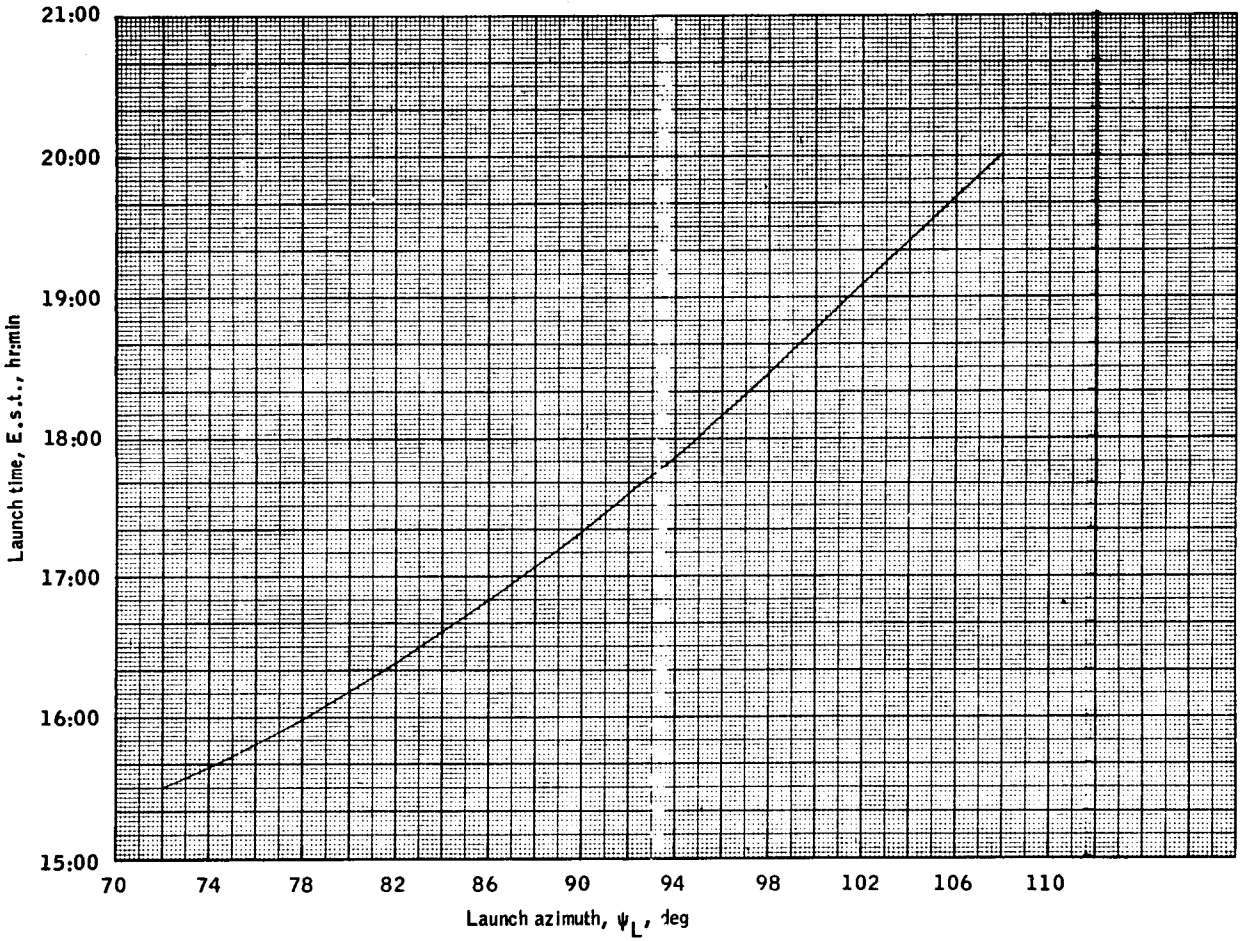
(mm) April 9, 1968

Figure 1.- Continued.



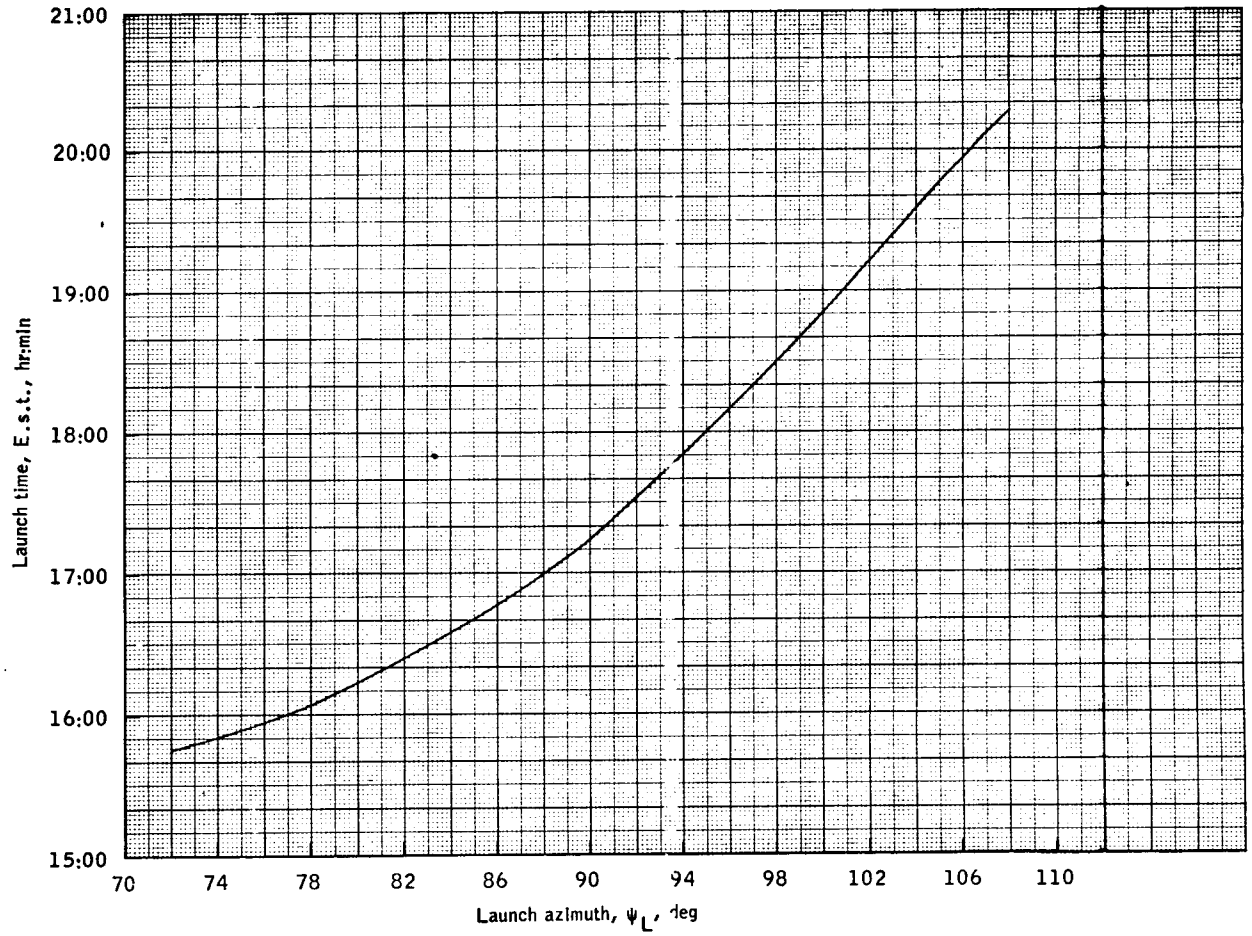
(nn) April 10, 1968

Figure 1.- Continued.



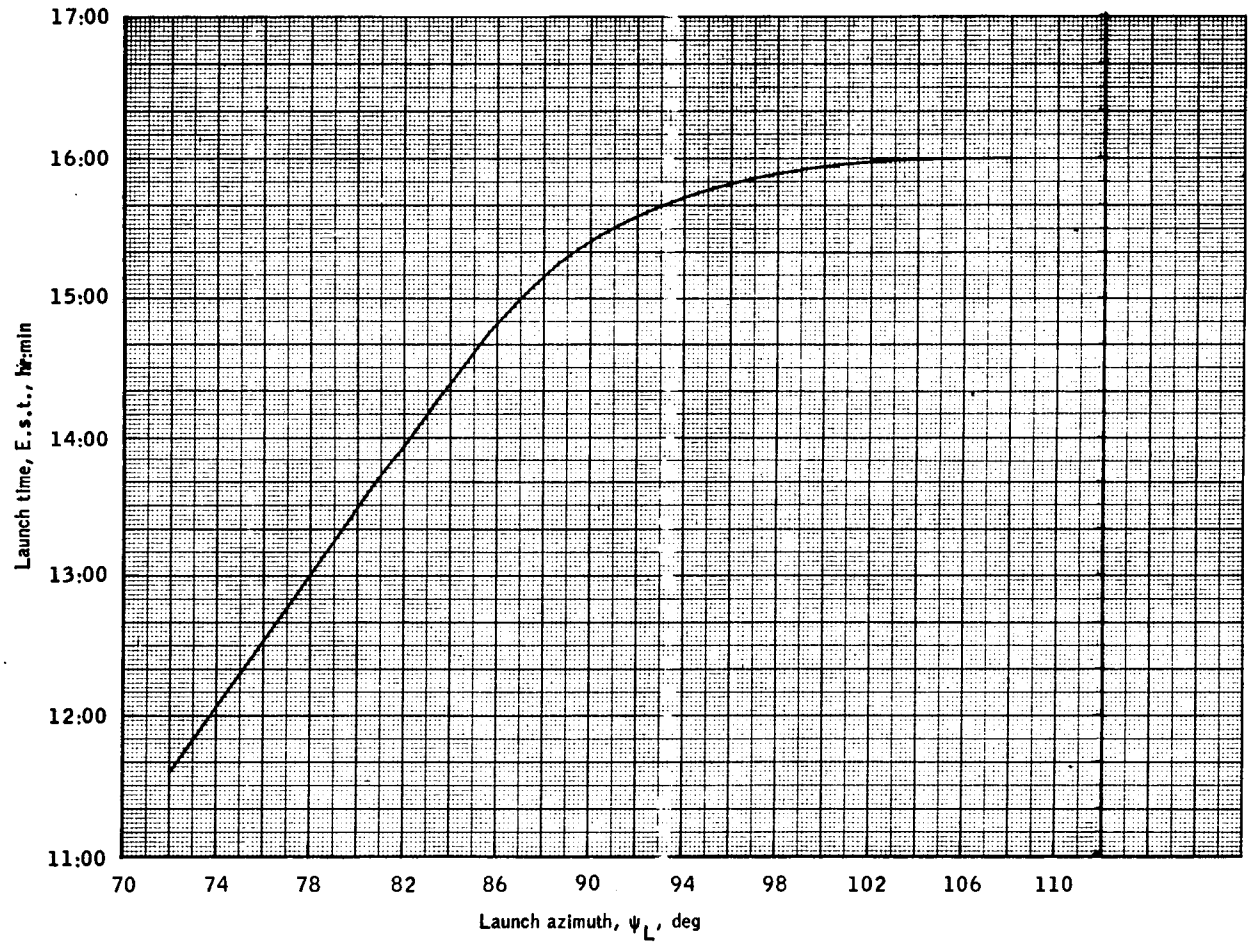
(oo) April 11, 1963.

Figure 1.- Continued.



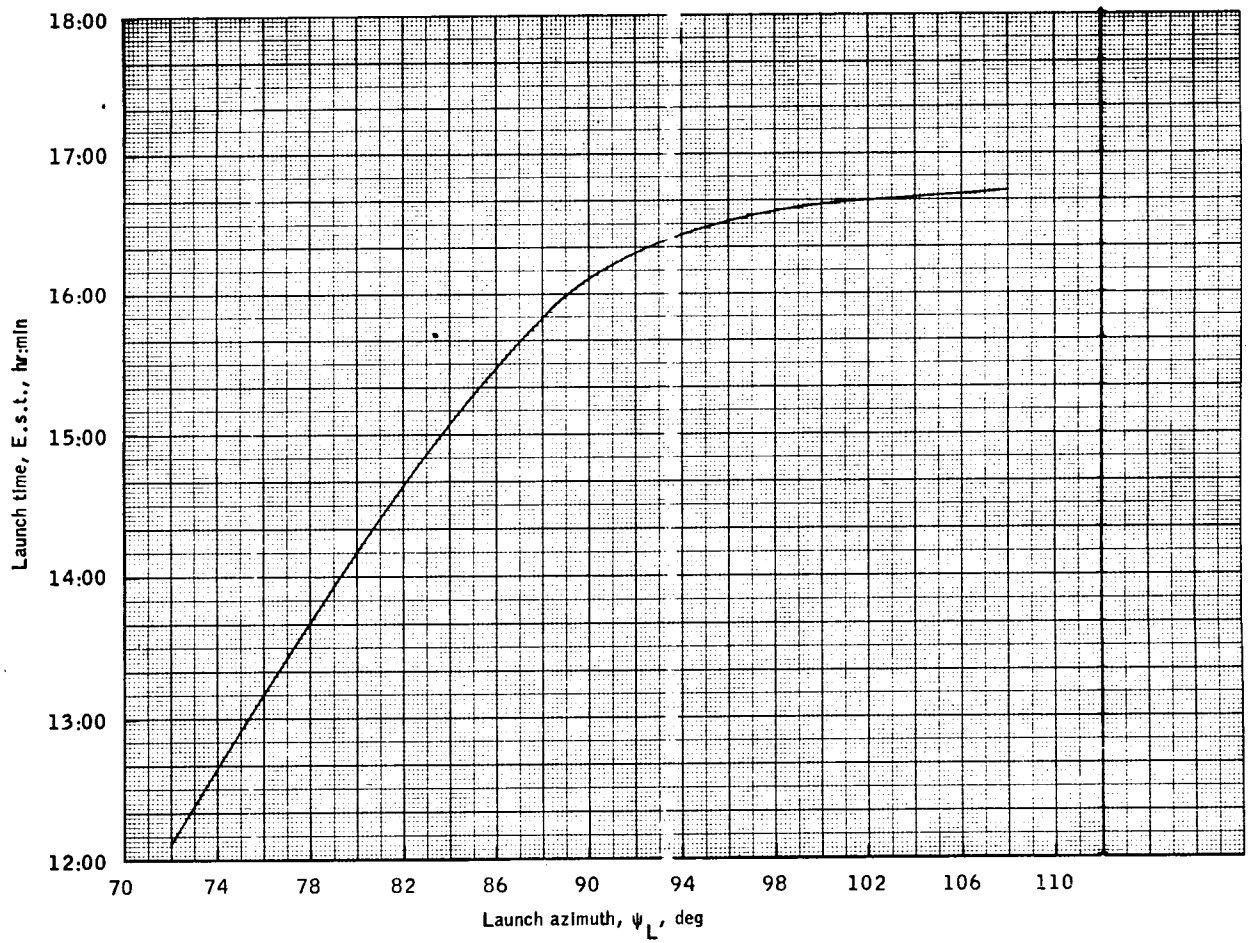
(pp) April 12, 1968.

Figure 1.- Continued.



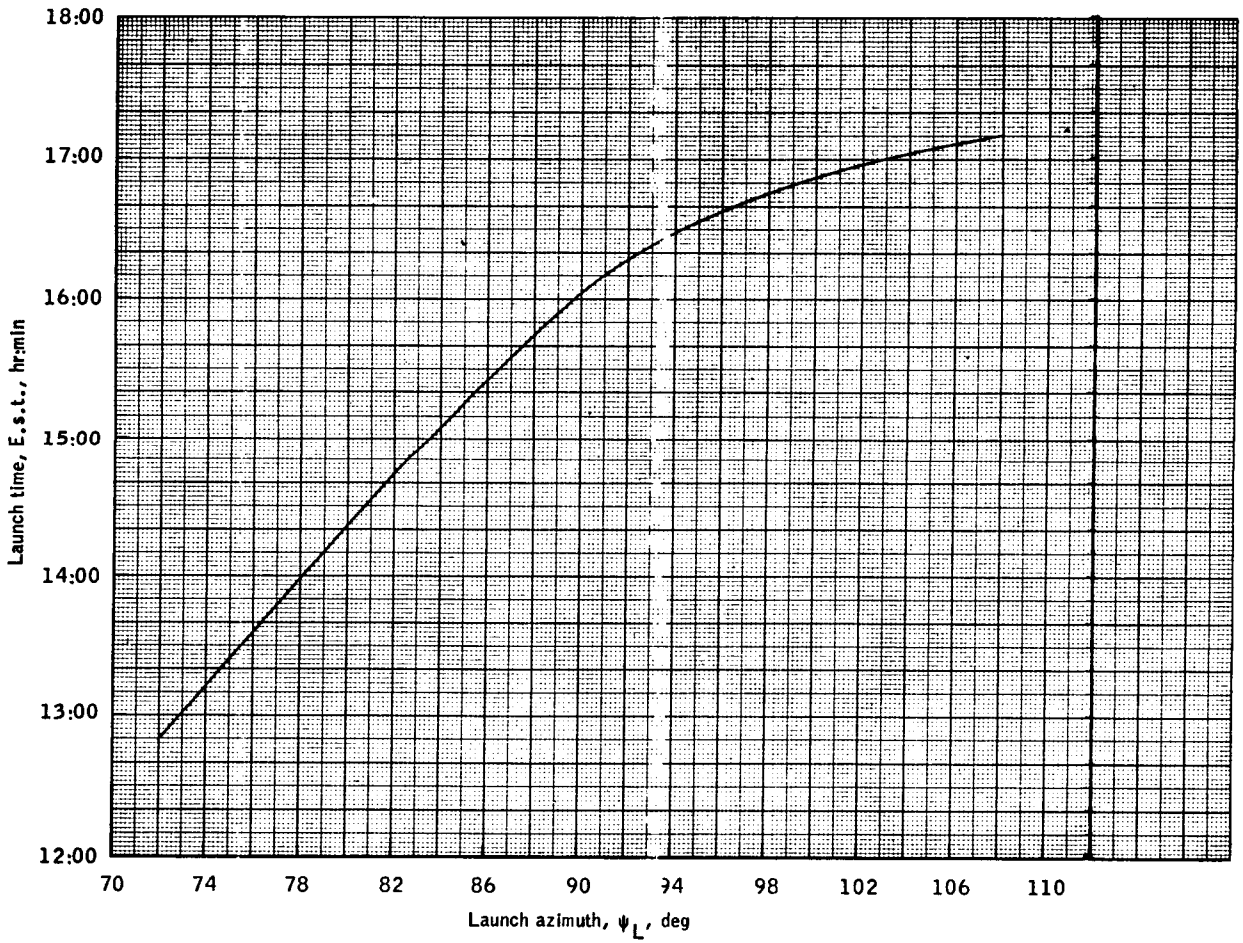
(qq) April 28, 1968.

Figure 1. - Continued.



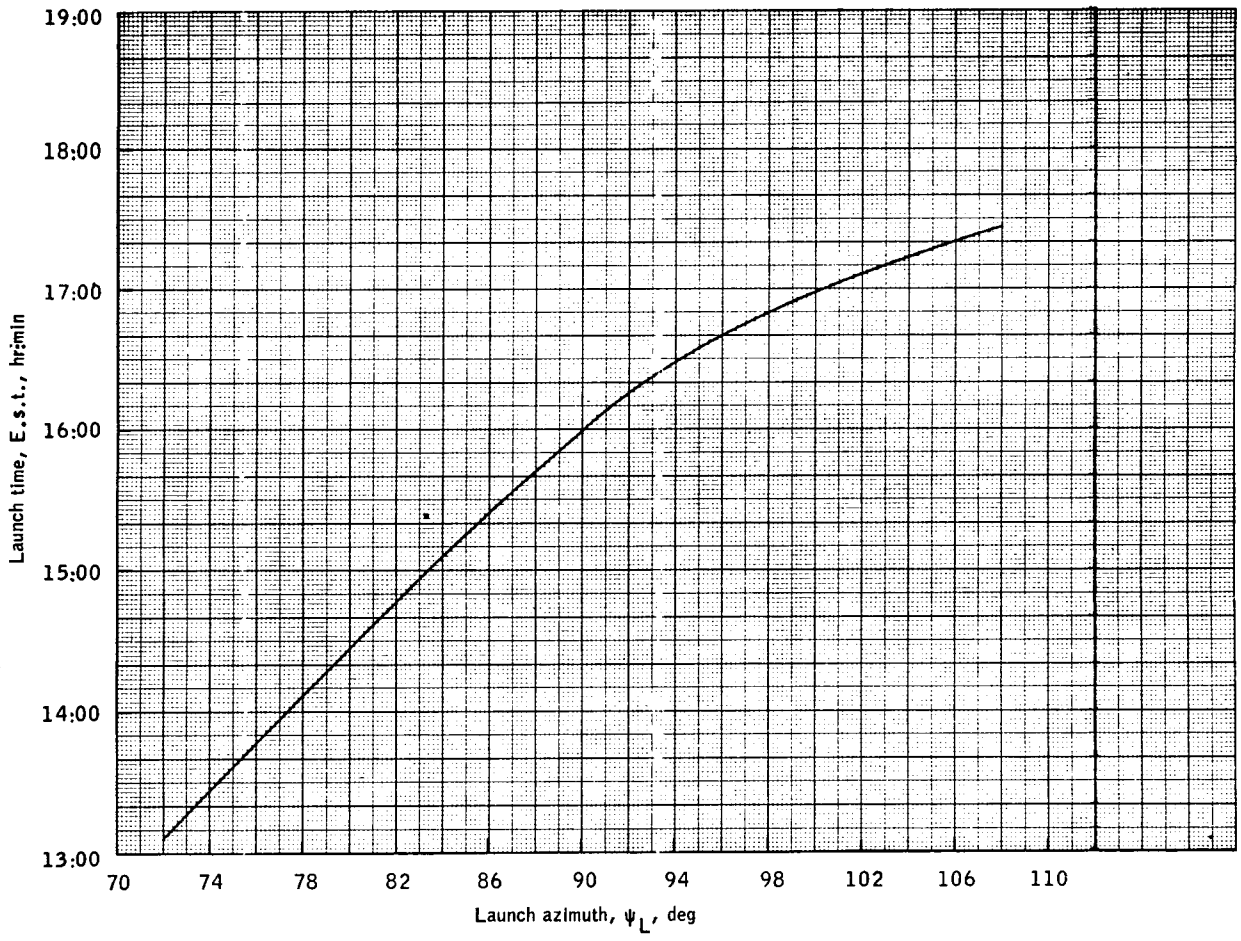
(rr) April 29, 1968.

Figure 1.- Continued.



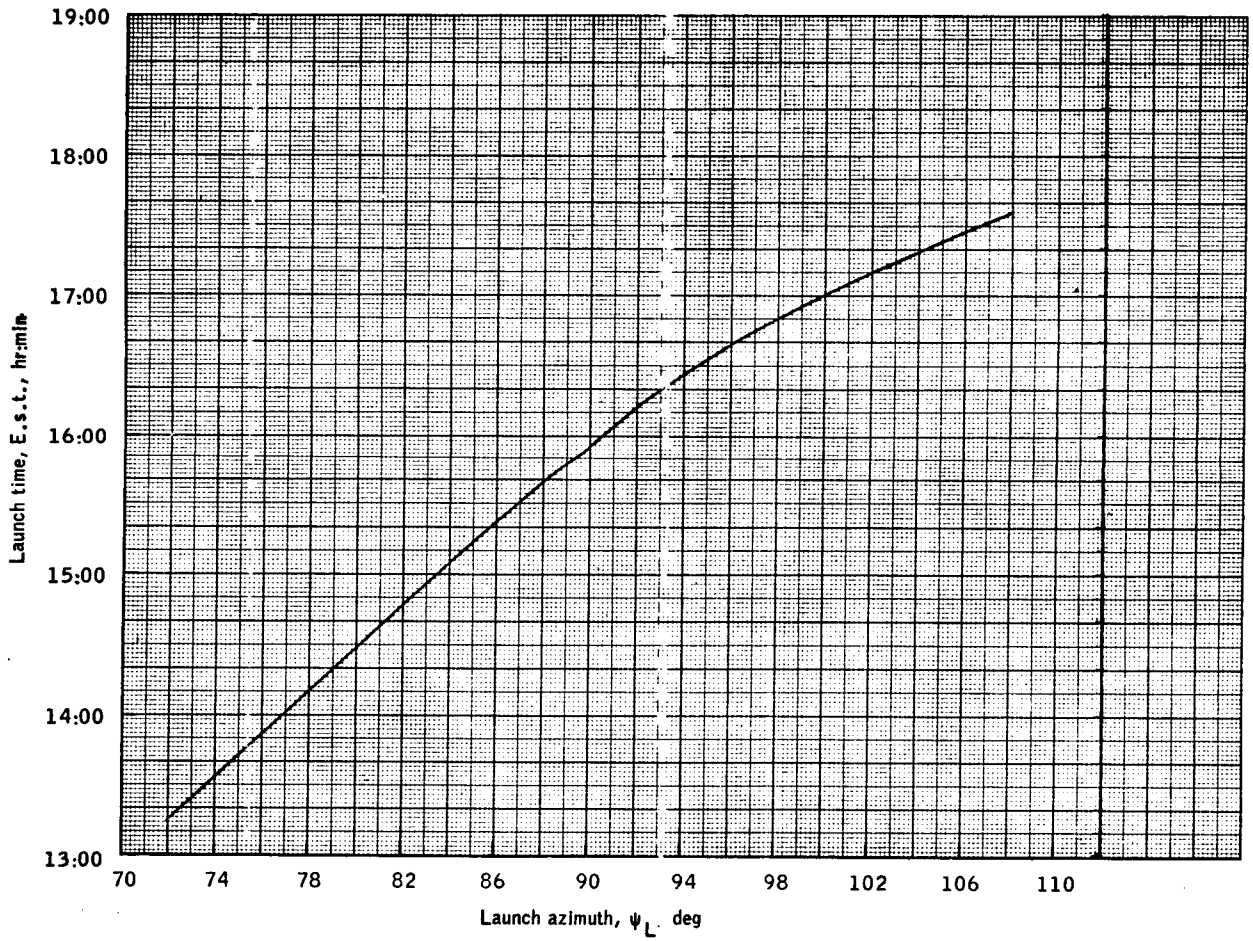
(ss) April 30, 196[illegible].

Figure 1.- Continued.



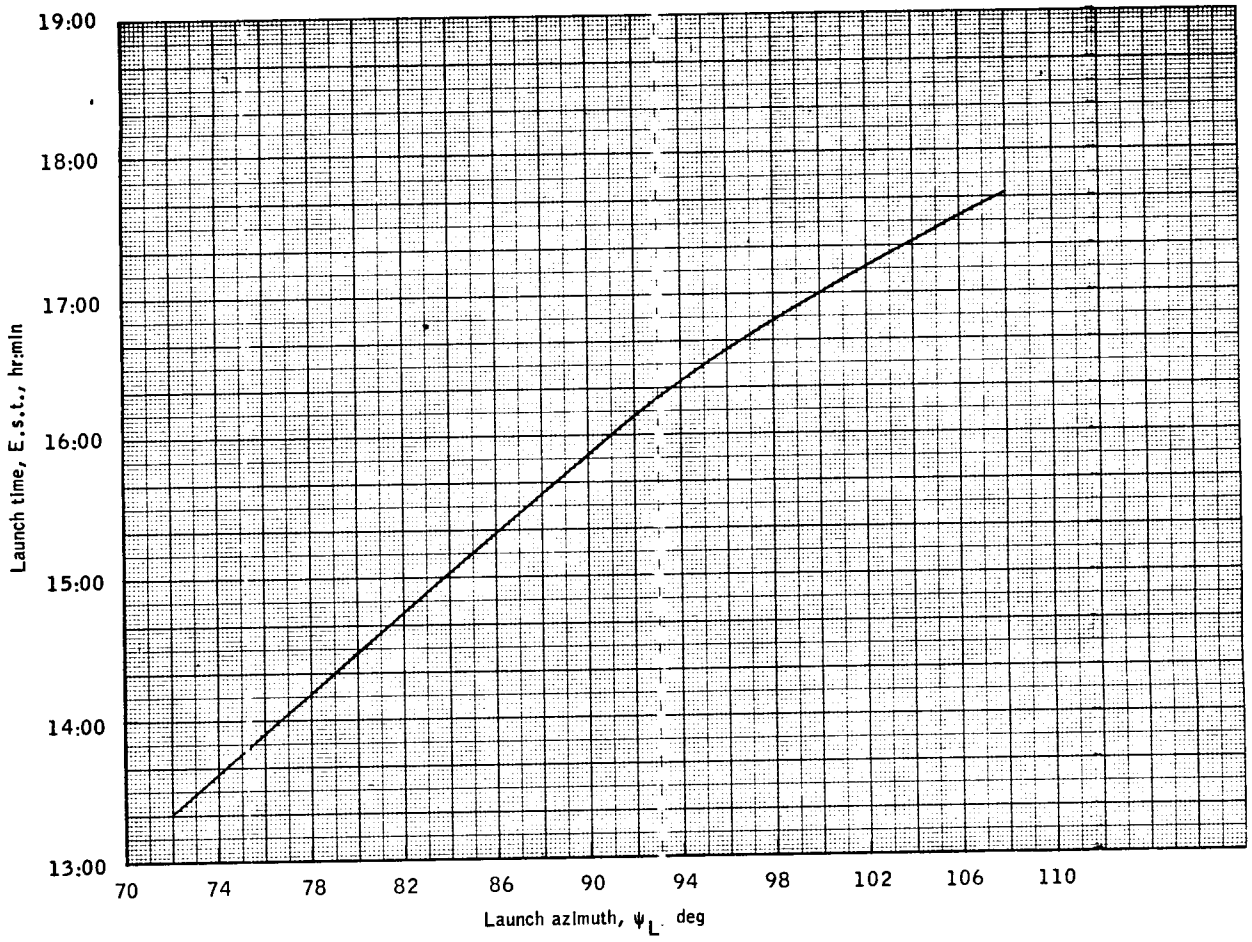
(tt) May 1, 1968

Figure 1.- Continued.



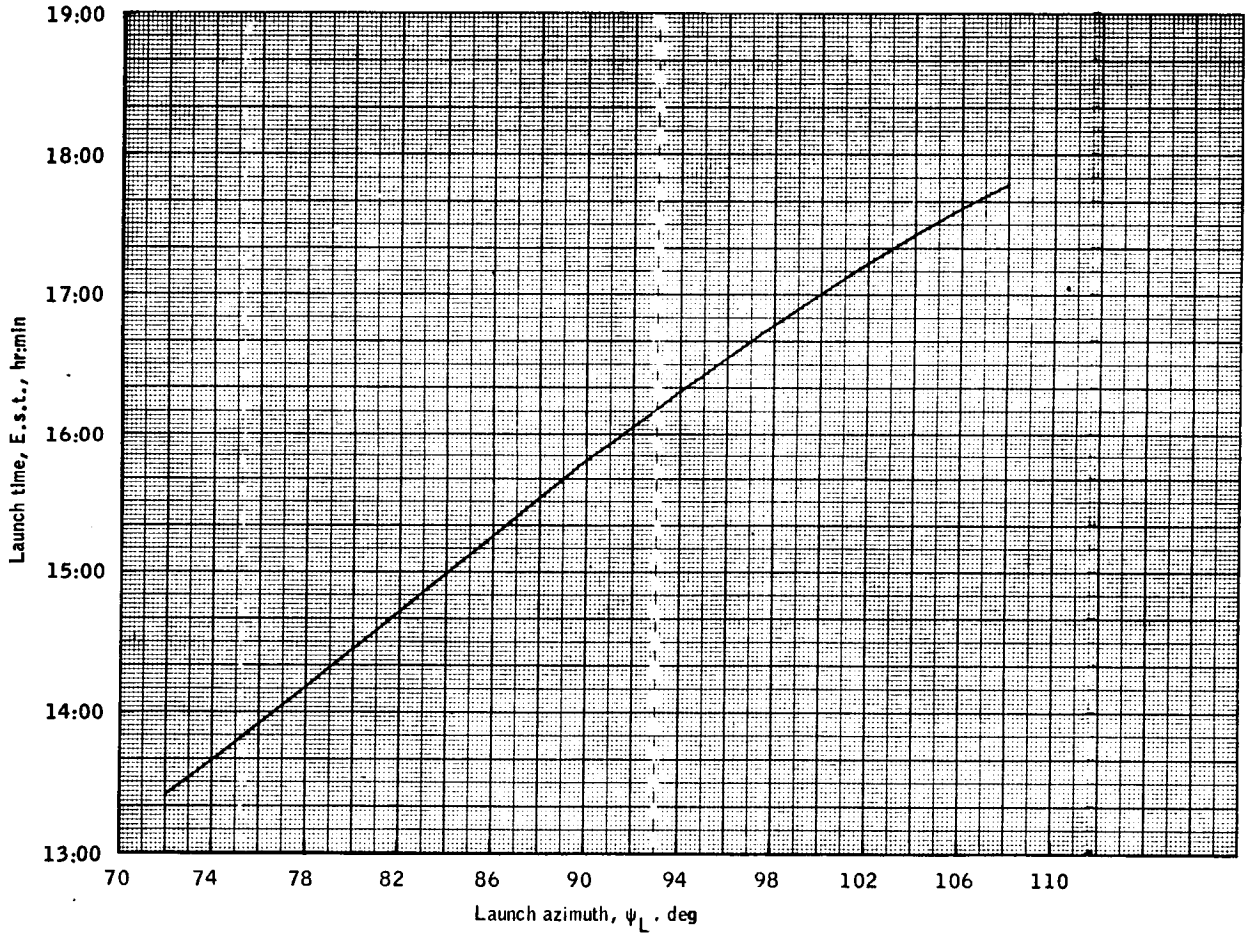
(uu) May 2, 1968.

Figure 1.- Continued.



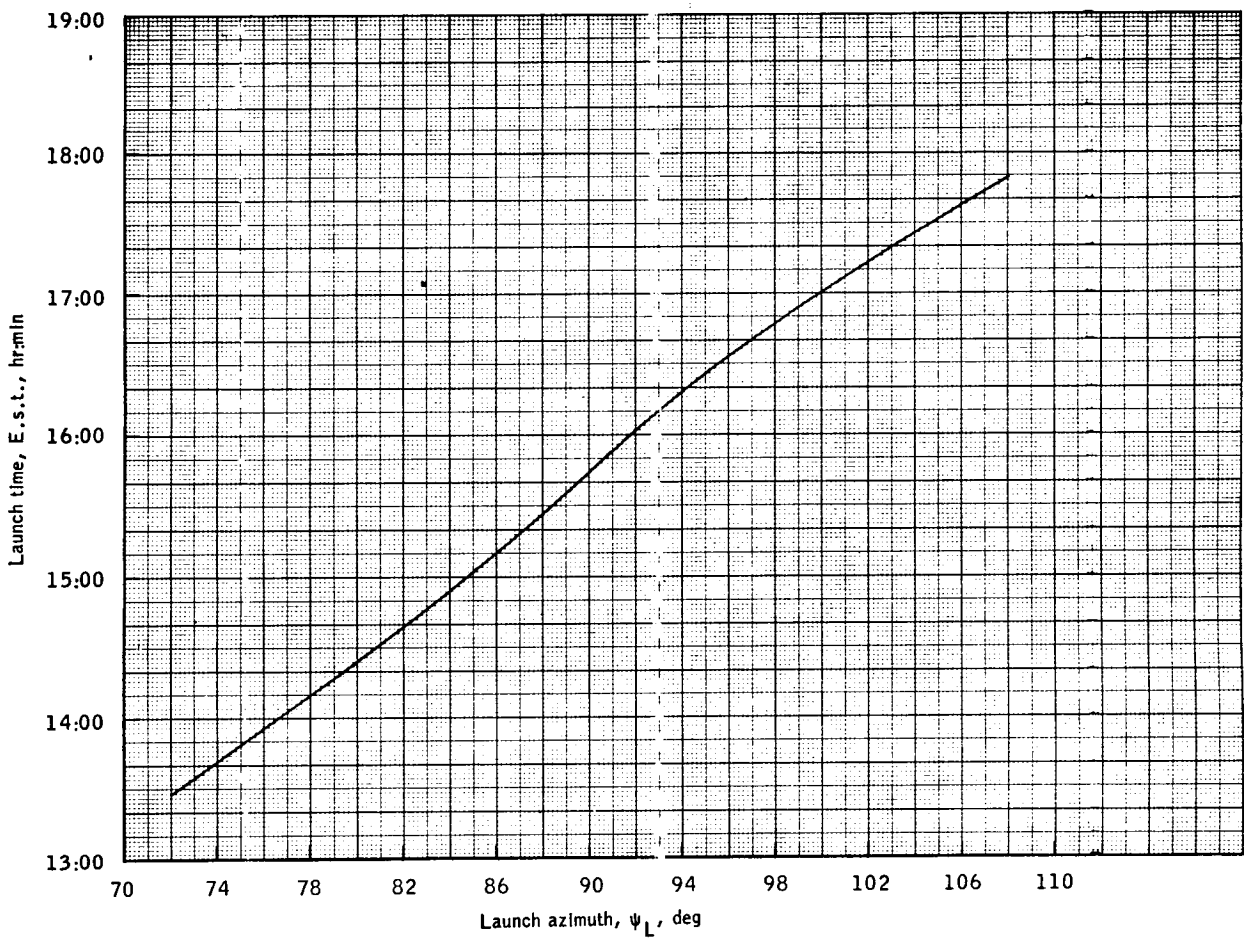
(vv) May 3, 1968.

Figure 1.- Continued.



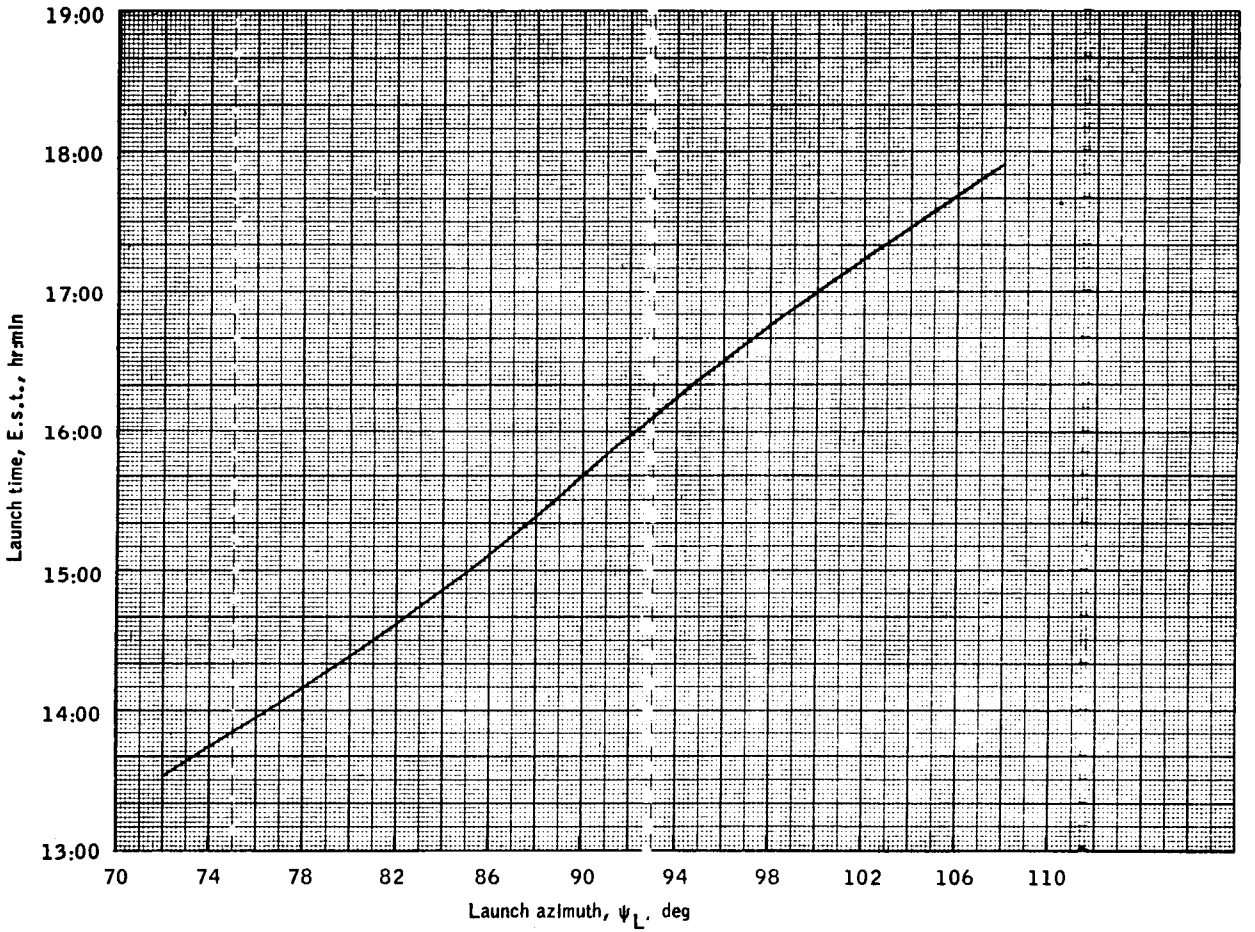
(ww) May 4, 1963.

Figure 1.- Continued.



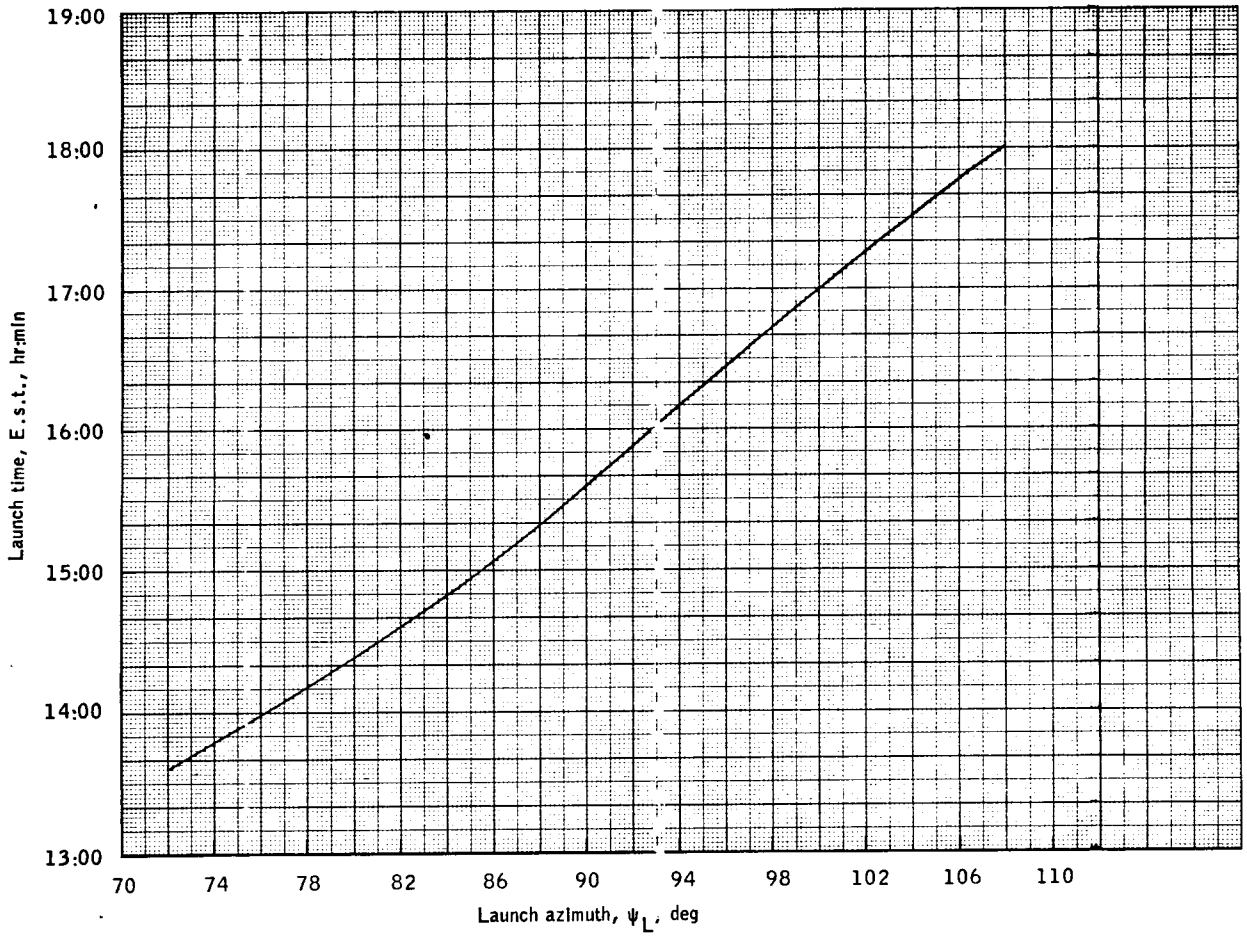
(xx) May 5, 1968.

Figure 1.- Continued.



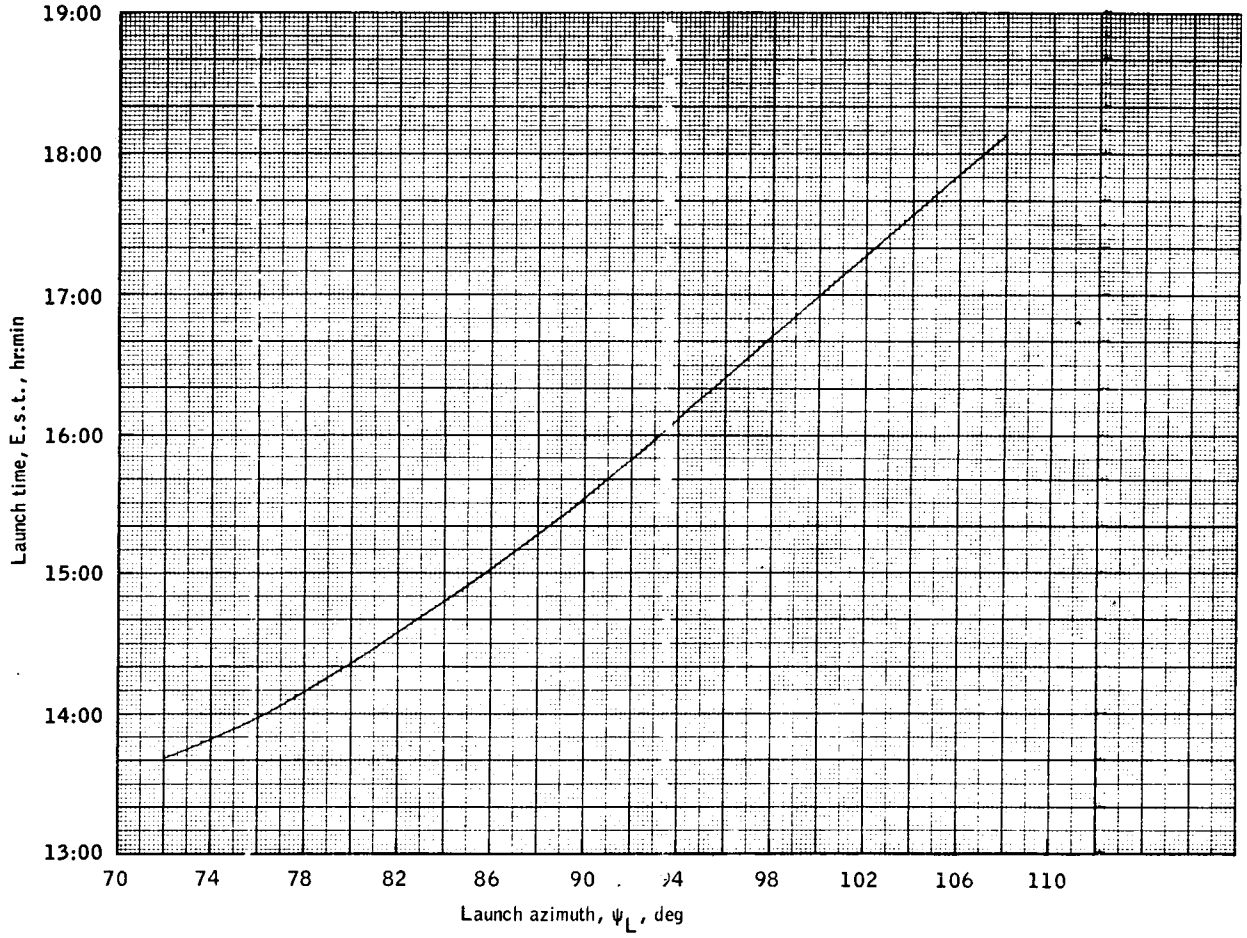
(yy) May 6, 1968.

Figure 1.- Continued.



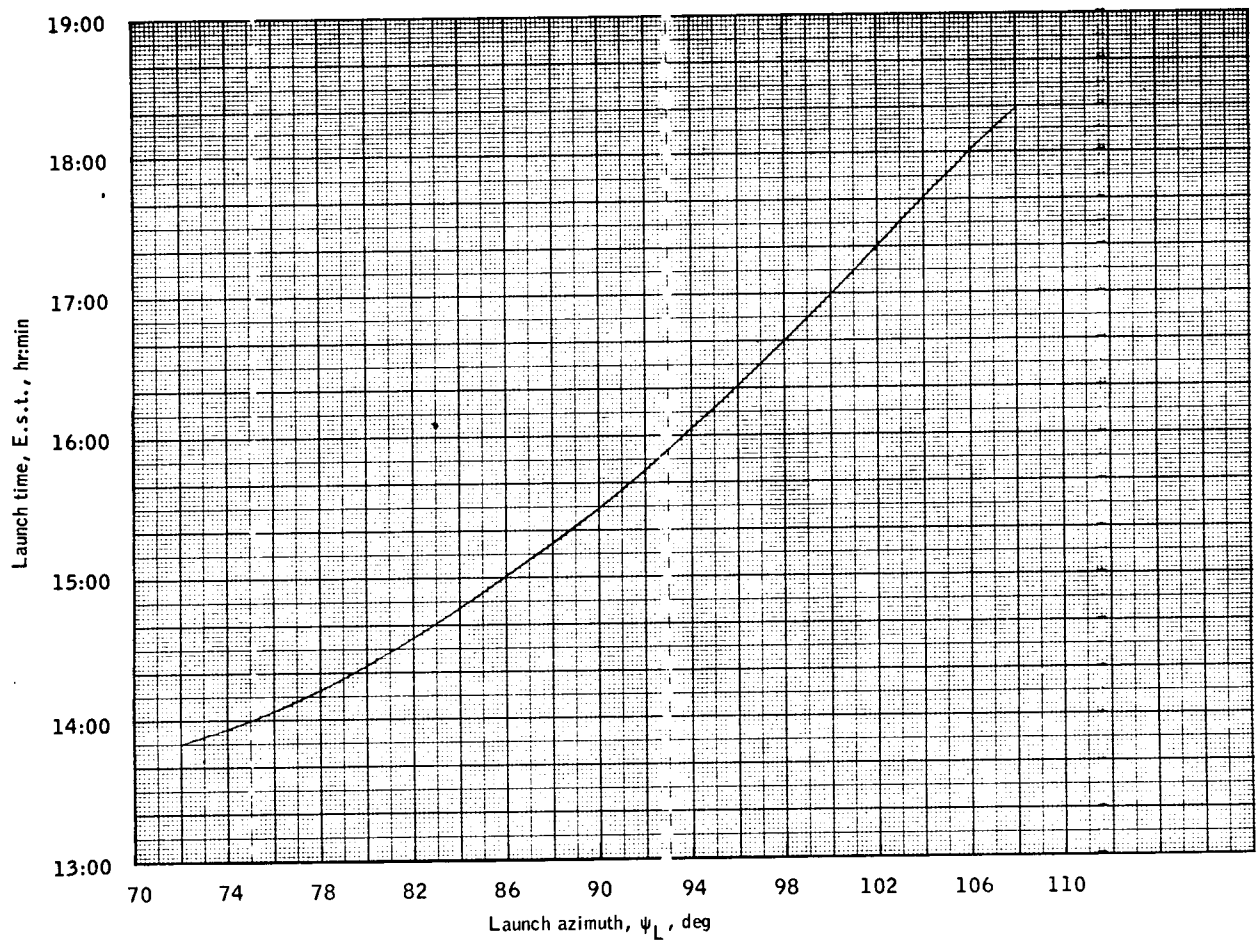
(zz) May 7, 1968.

Figure 1.- Continued.



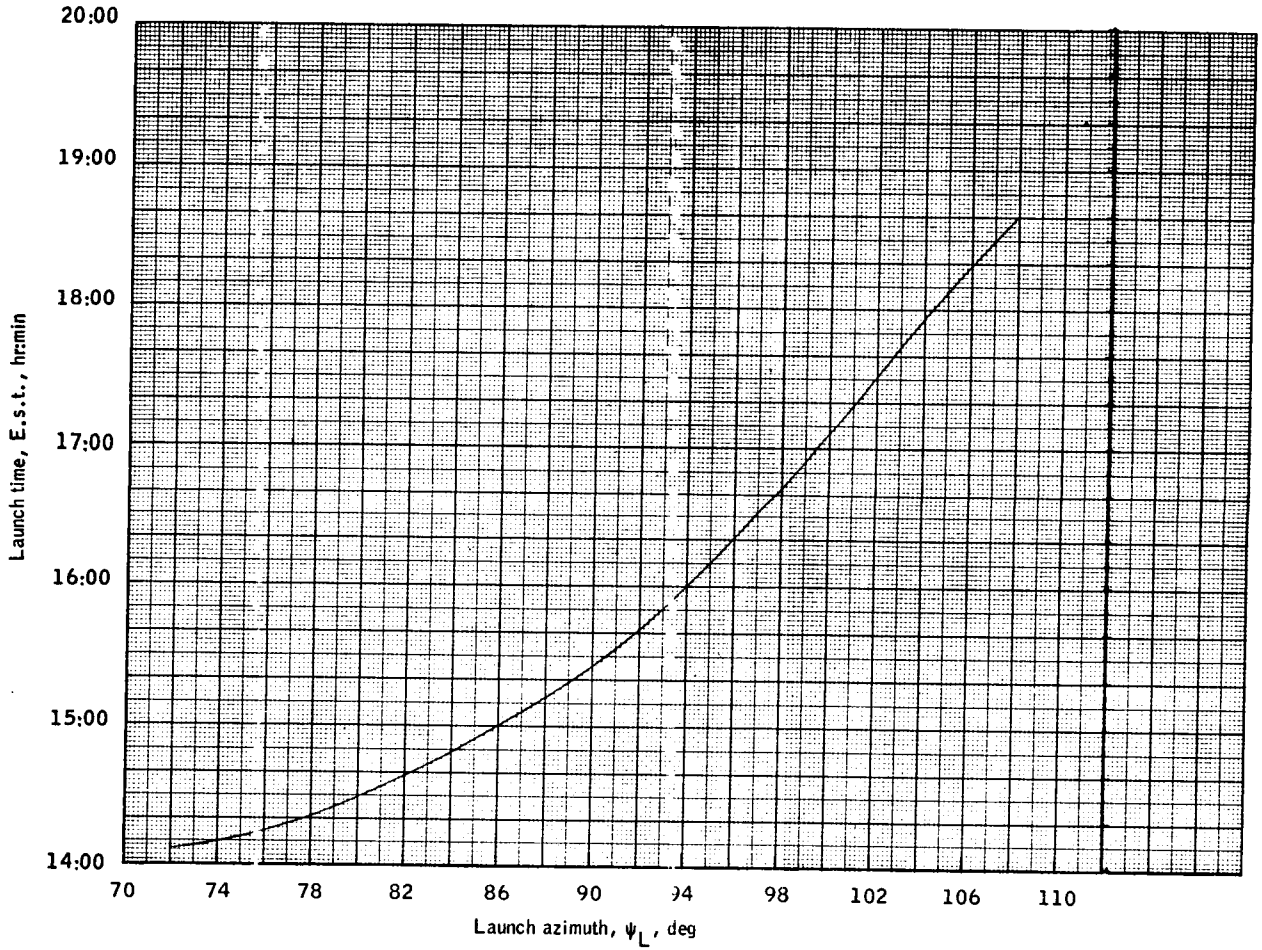
(aaa) May 8, 1968.

Figure 1.- Continued.



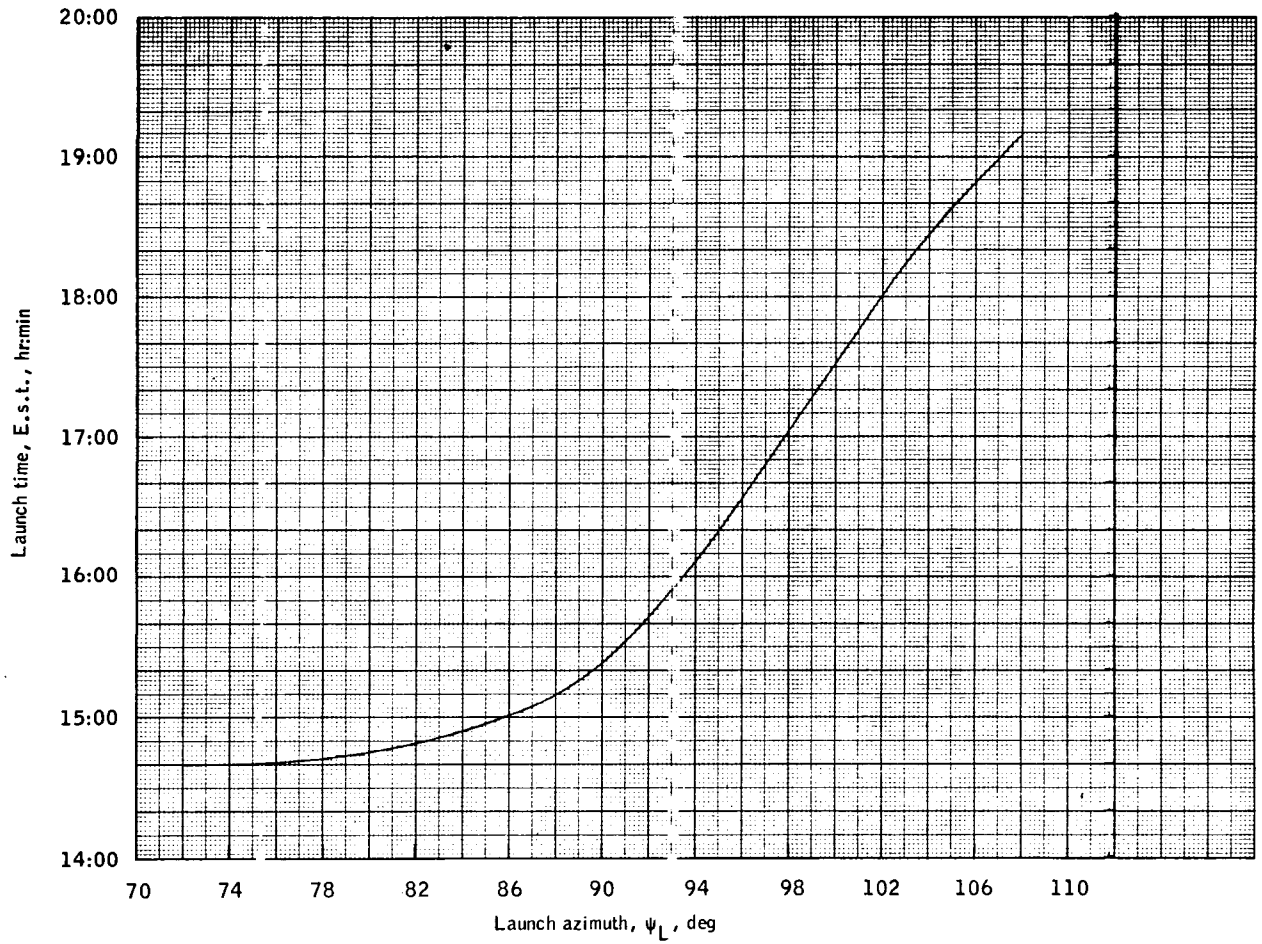
(bbb) May 9, 1968.

Figure 1.- Continued.



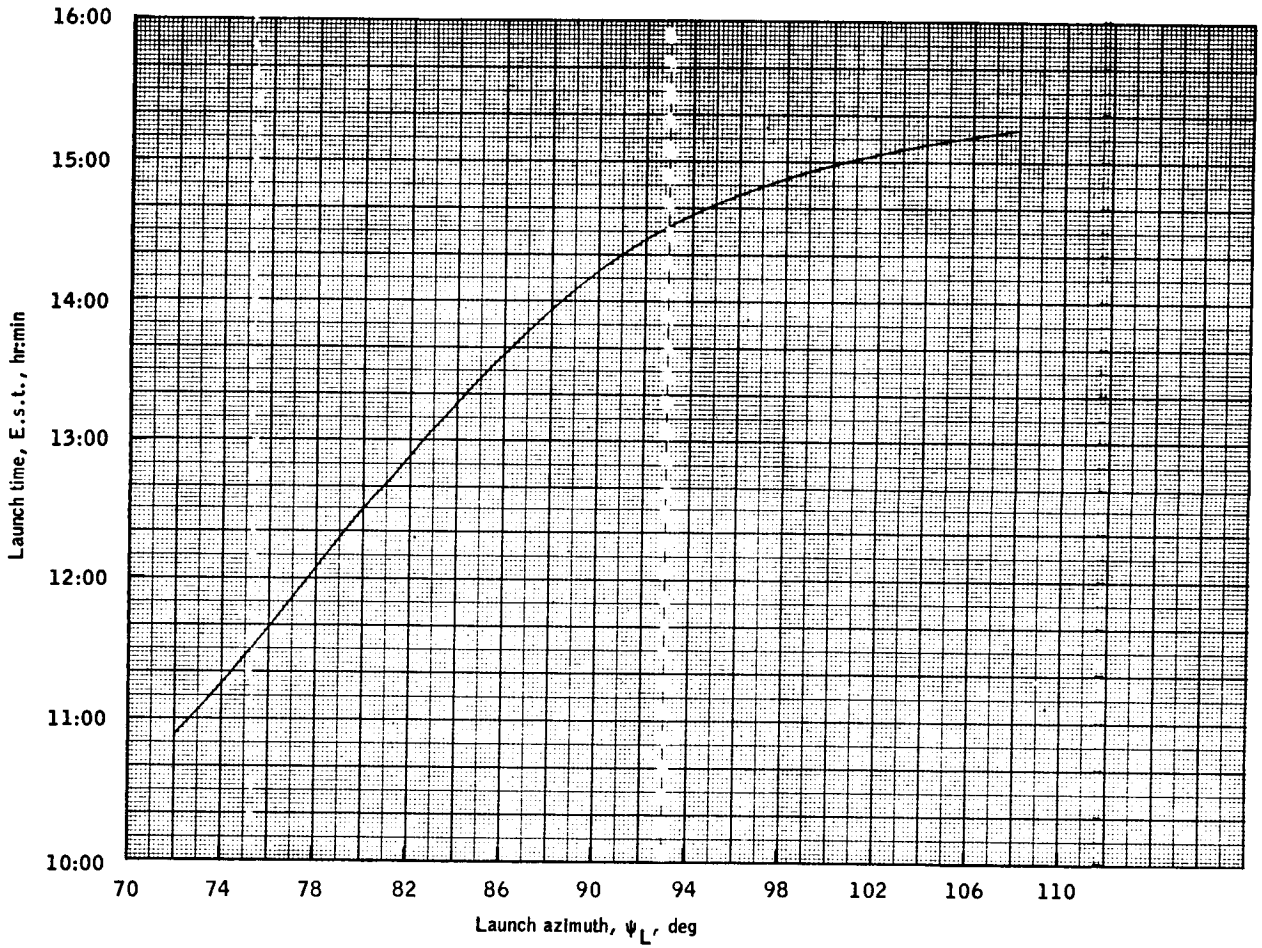
(ccc) May 10, 1968.

Figure 1. - Continued.



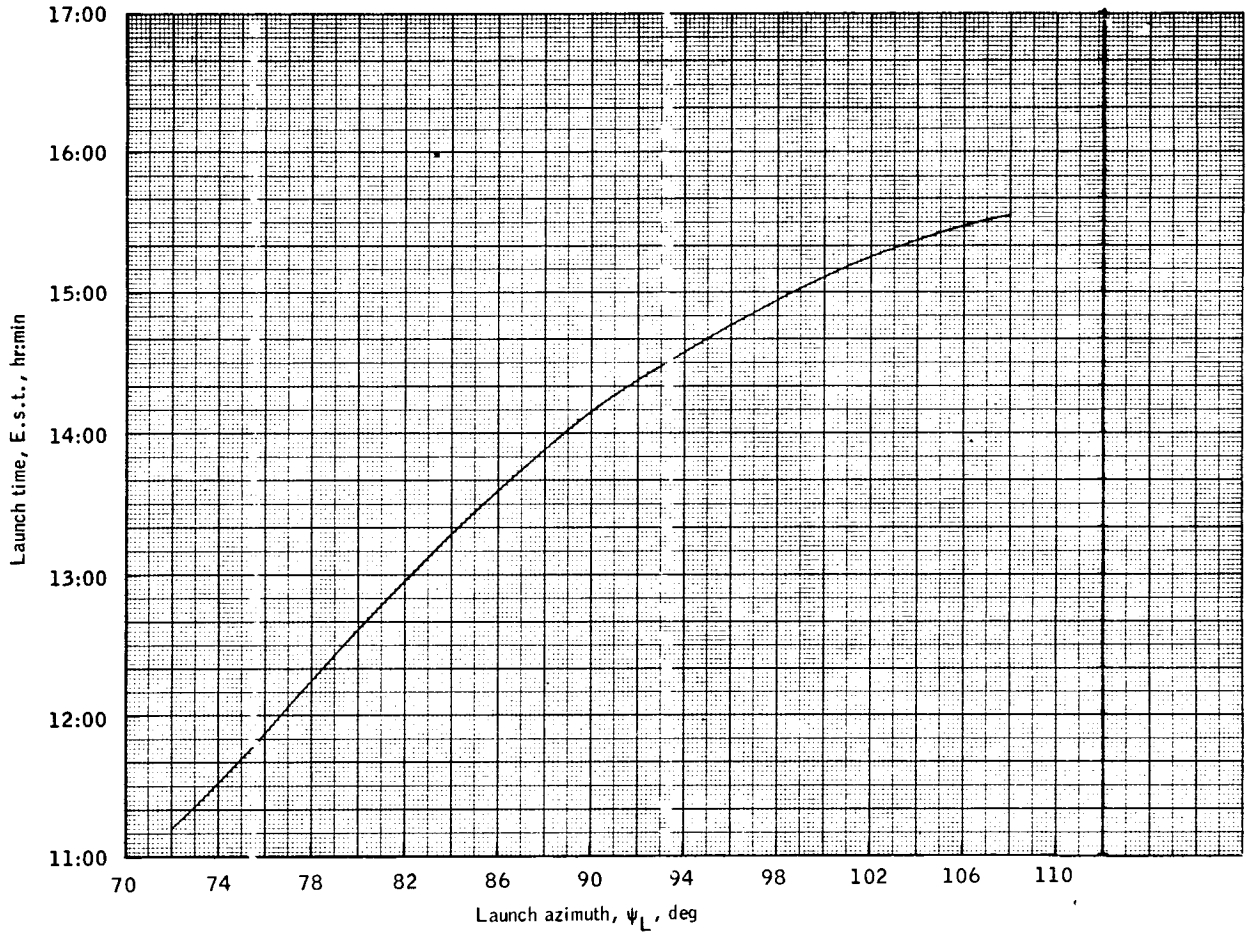
(ddd) May 11, 1968.

Figure 1. - Continued.



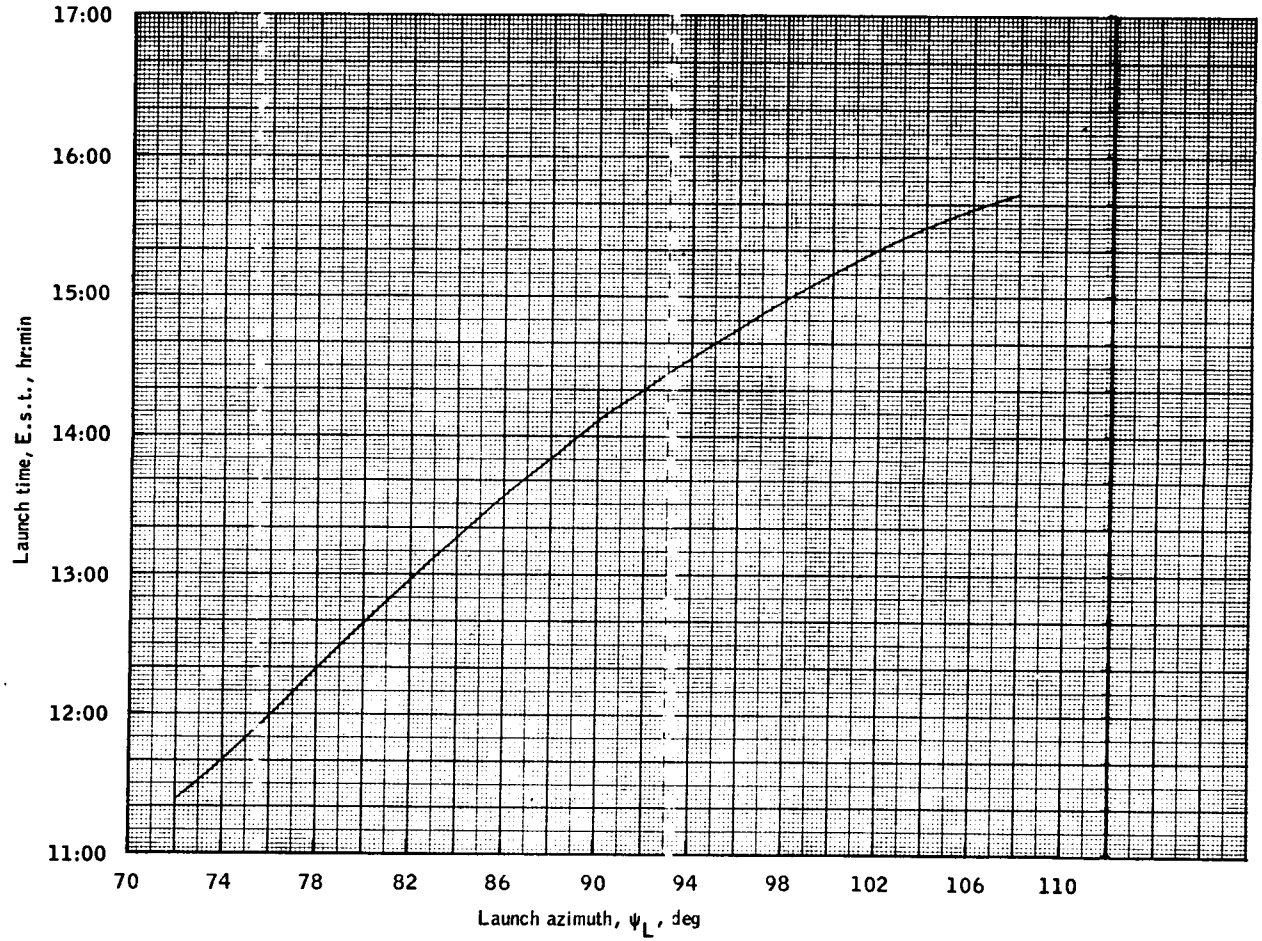
(eee) May 27, 1958.

Figure 1. - Continued.



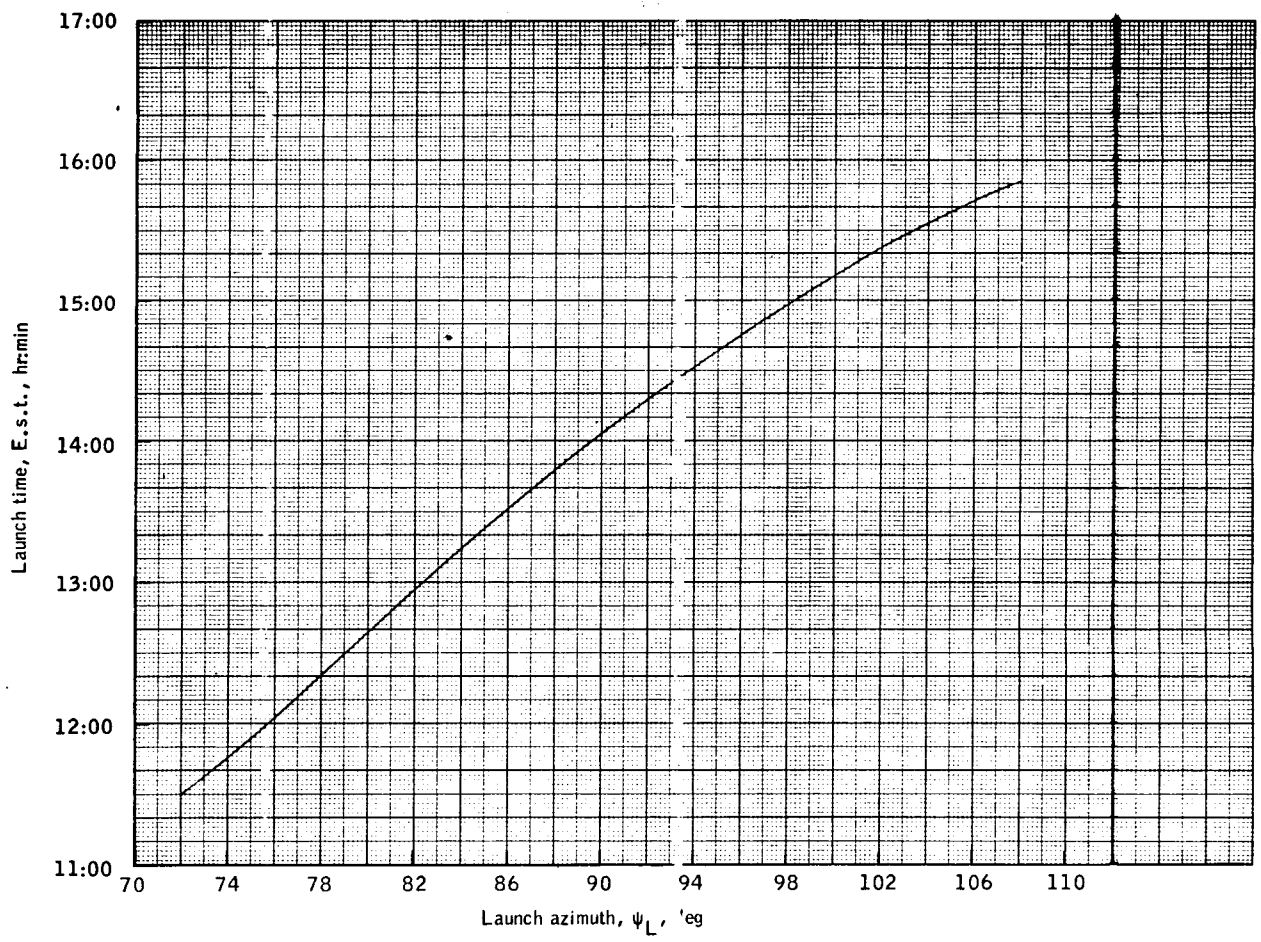
(fff) May 28, 1963.

Figure 1. - Continued.



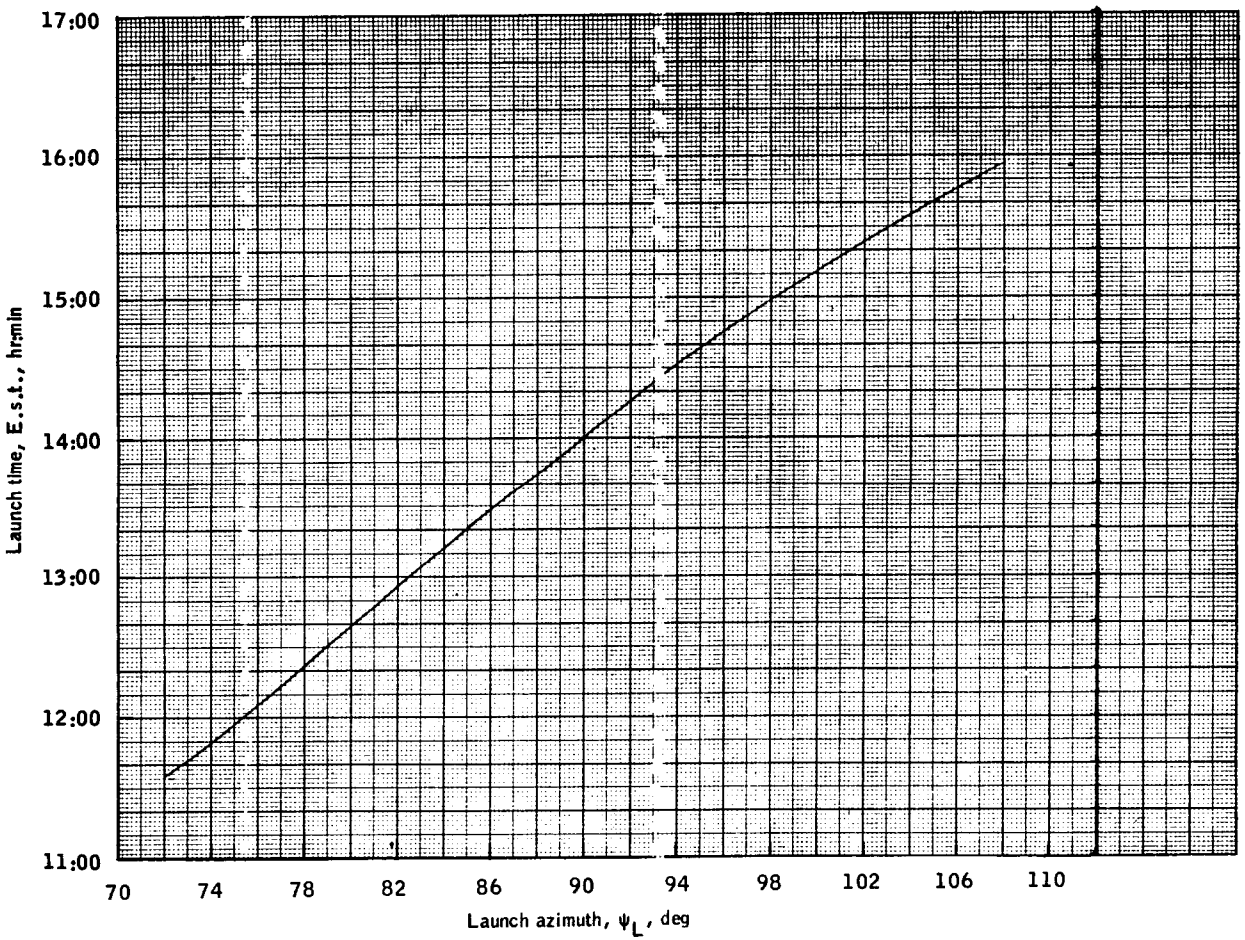
(ggg) May 29, 1968.

Figure 1.- Continued.



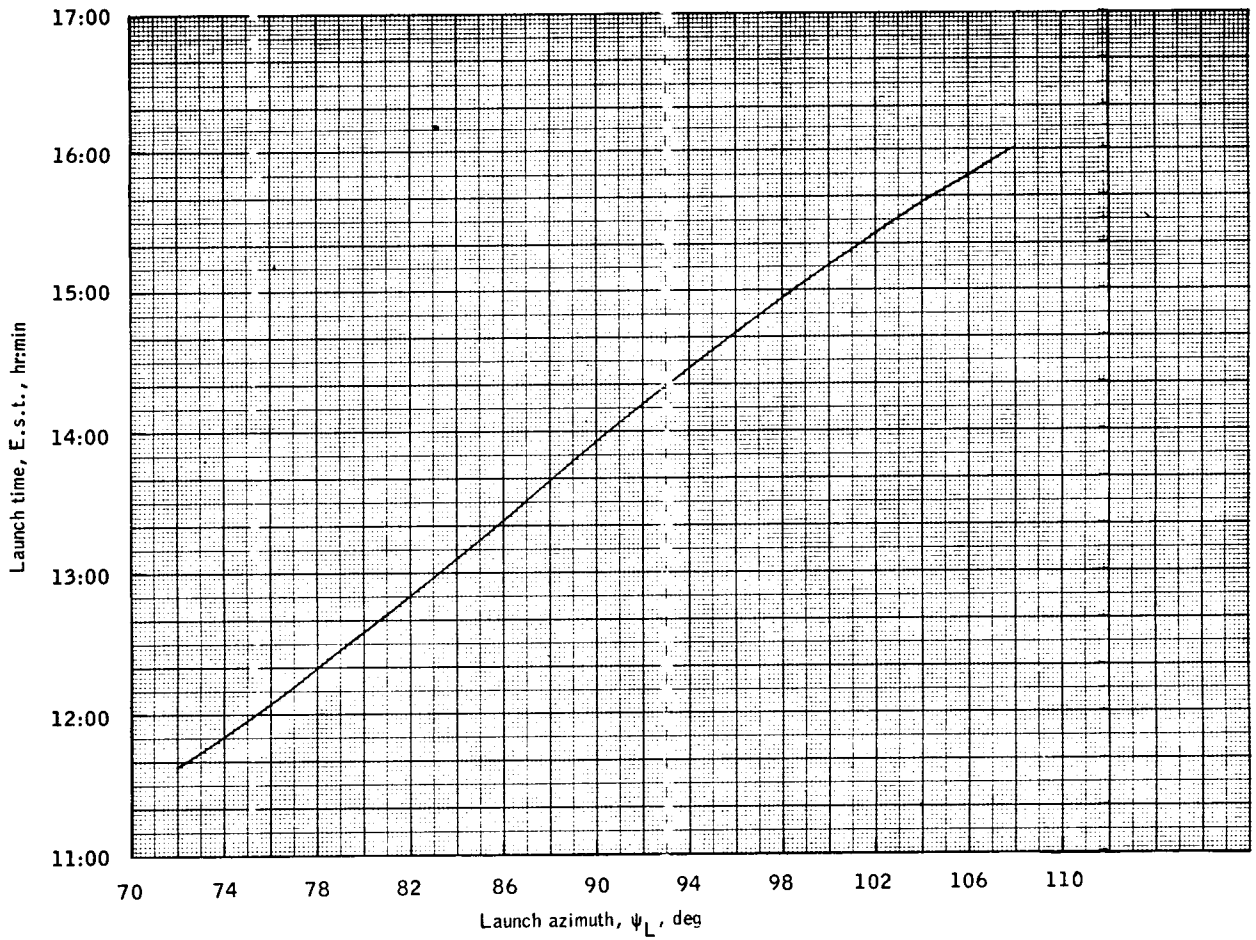
(hhh) May 30, 1968.

Figure 1.- Continued.



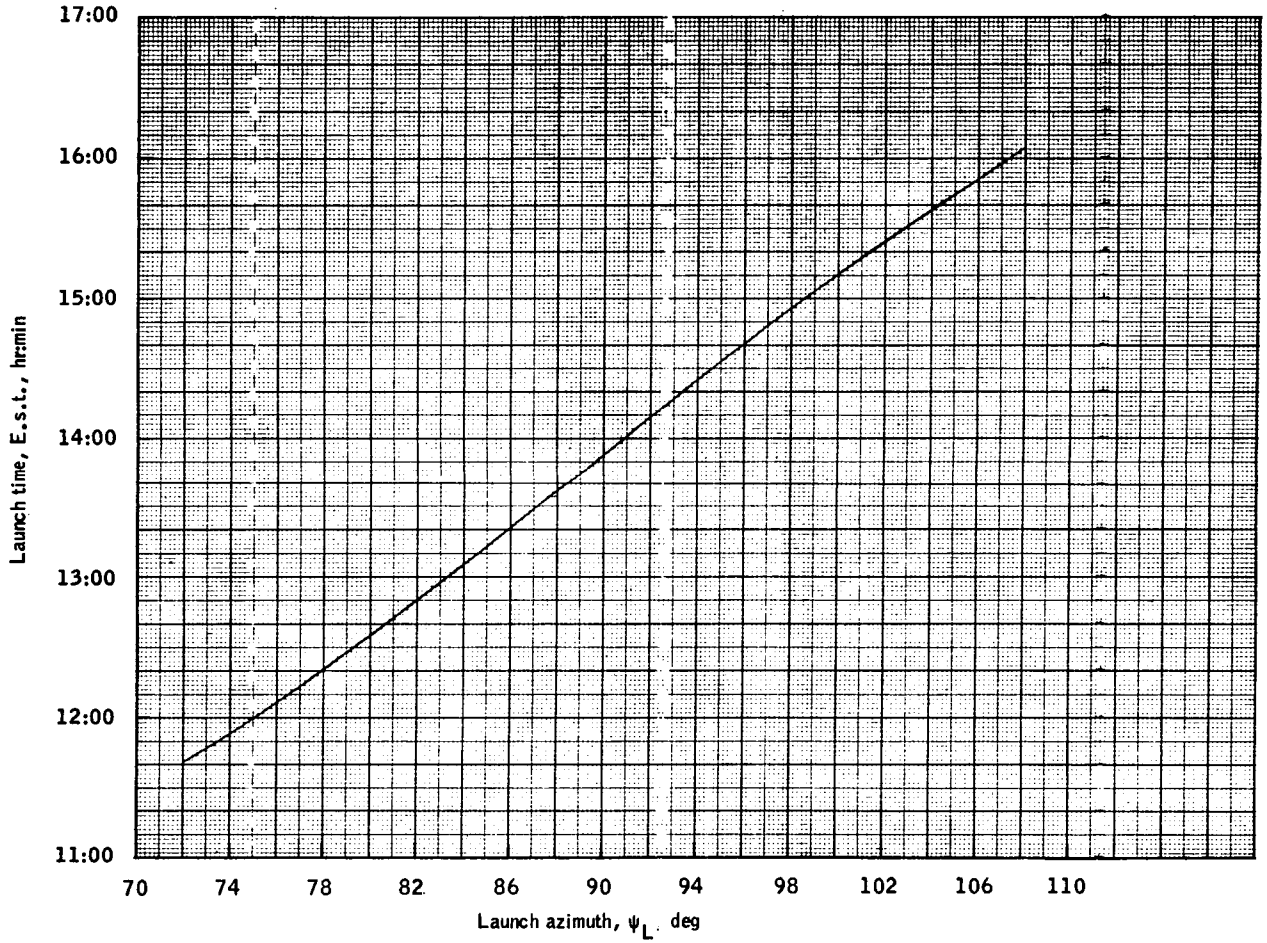
(iii) May 31, 1968.

Figure 1.- Continued.



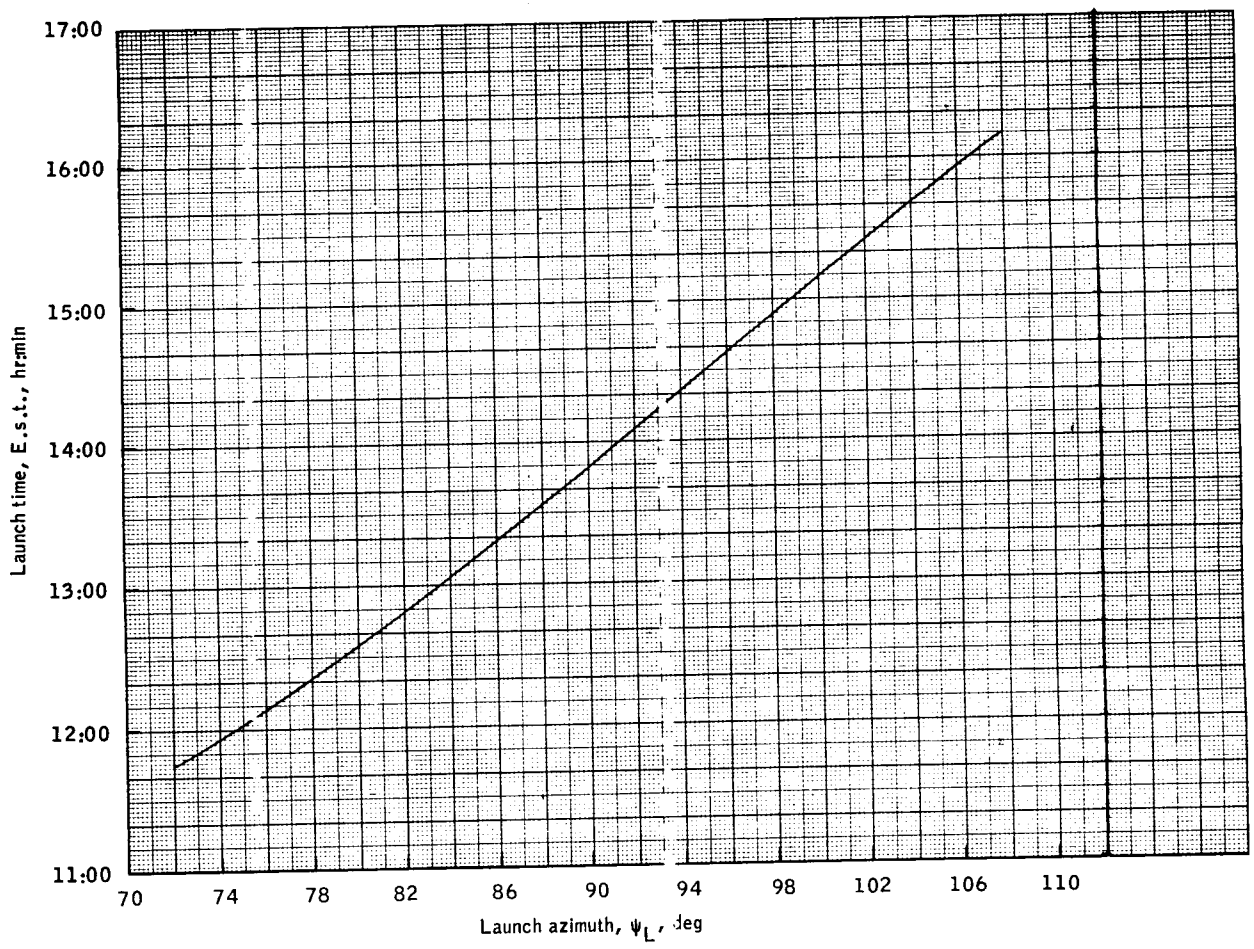
(jjj) June 1, 1963.

Figure 1.- Contin ed.



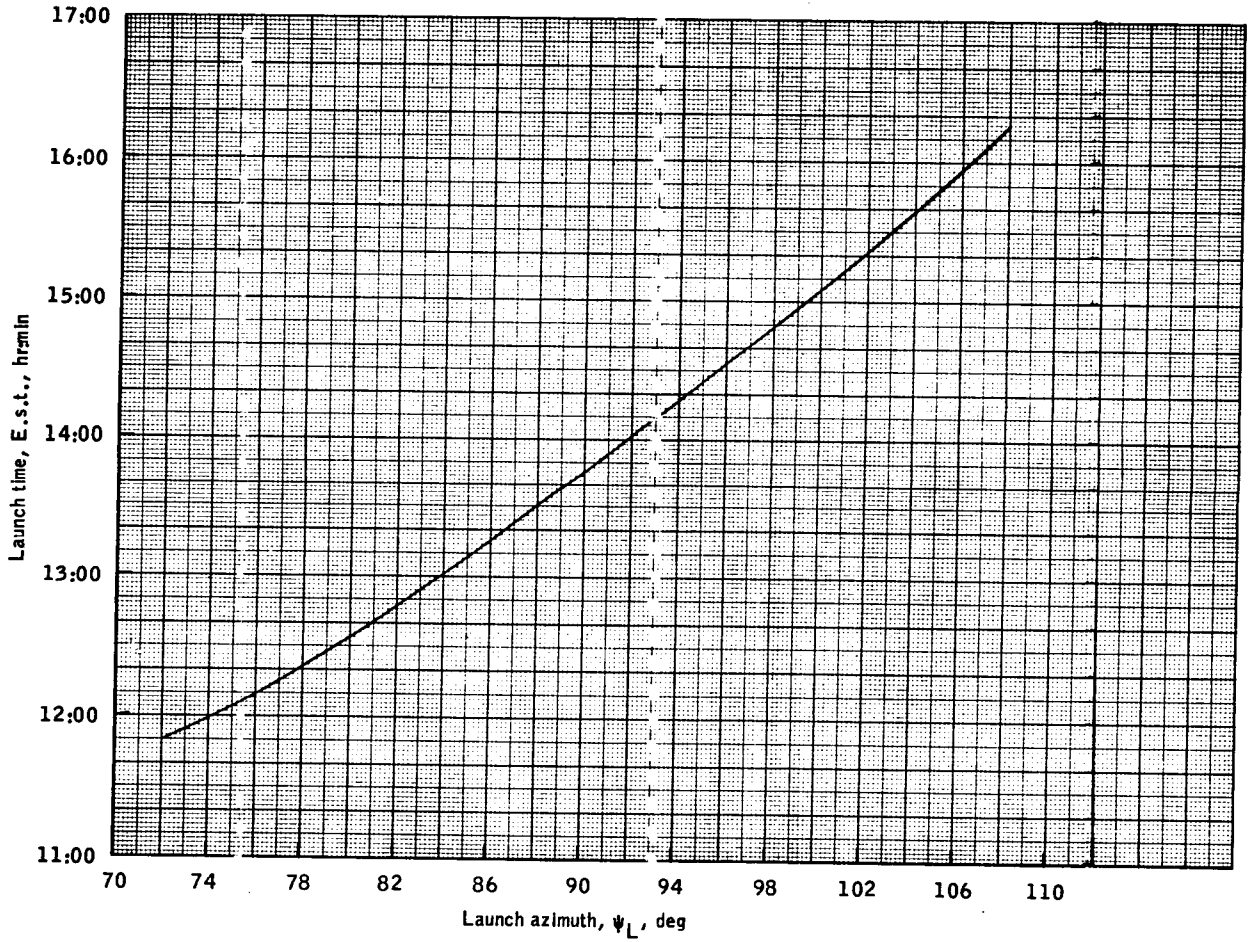
(kkk) June 2, 1968.

Figure 1.- Continued.



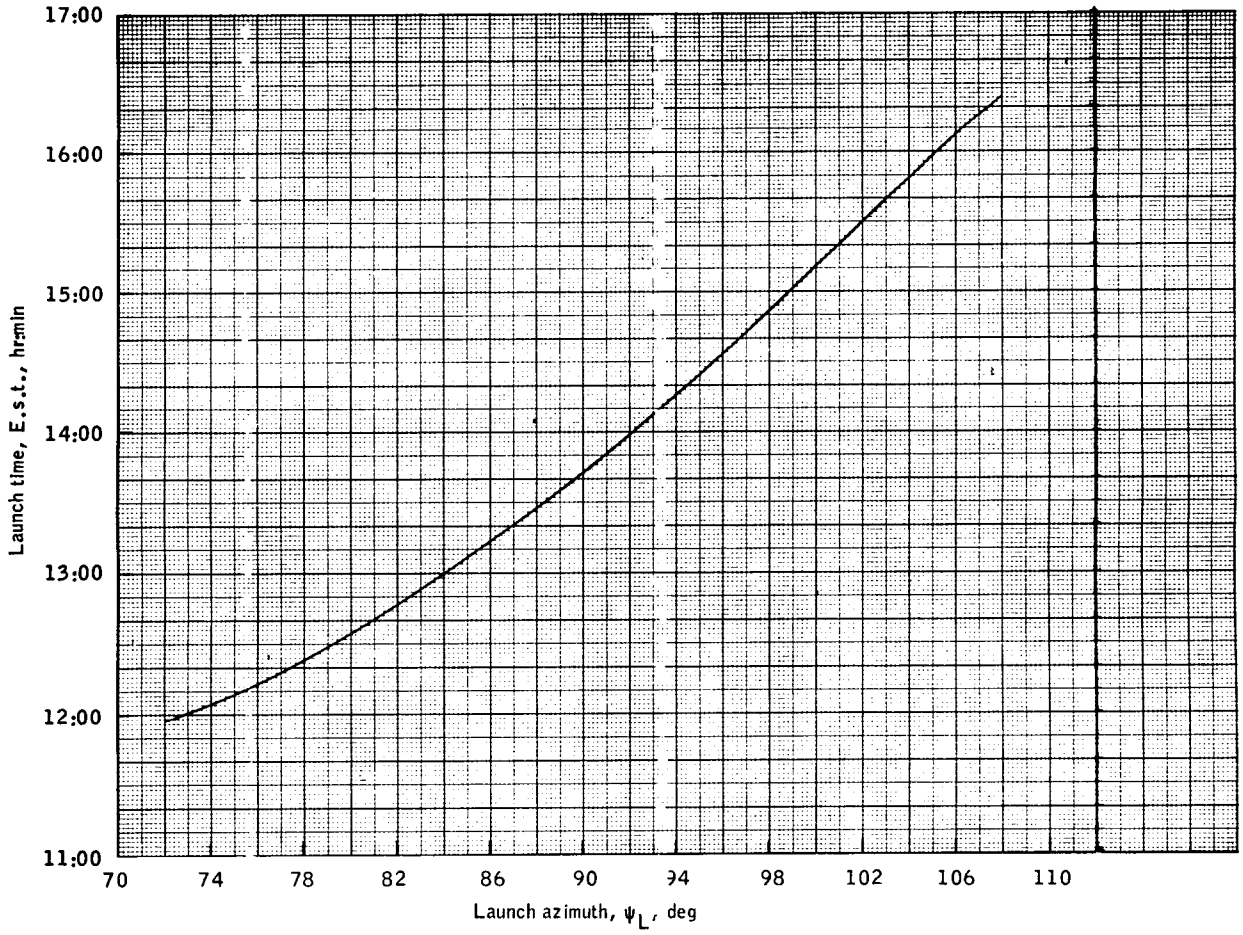
(III) June 3, 1968.

Figure 1.- Continued.



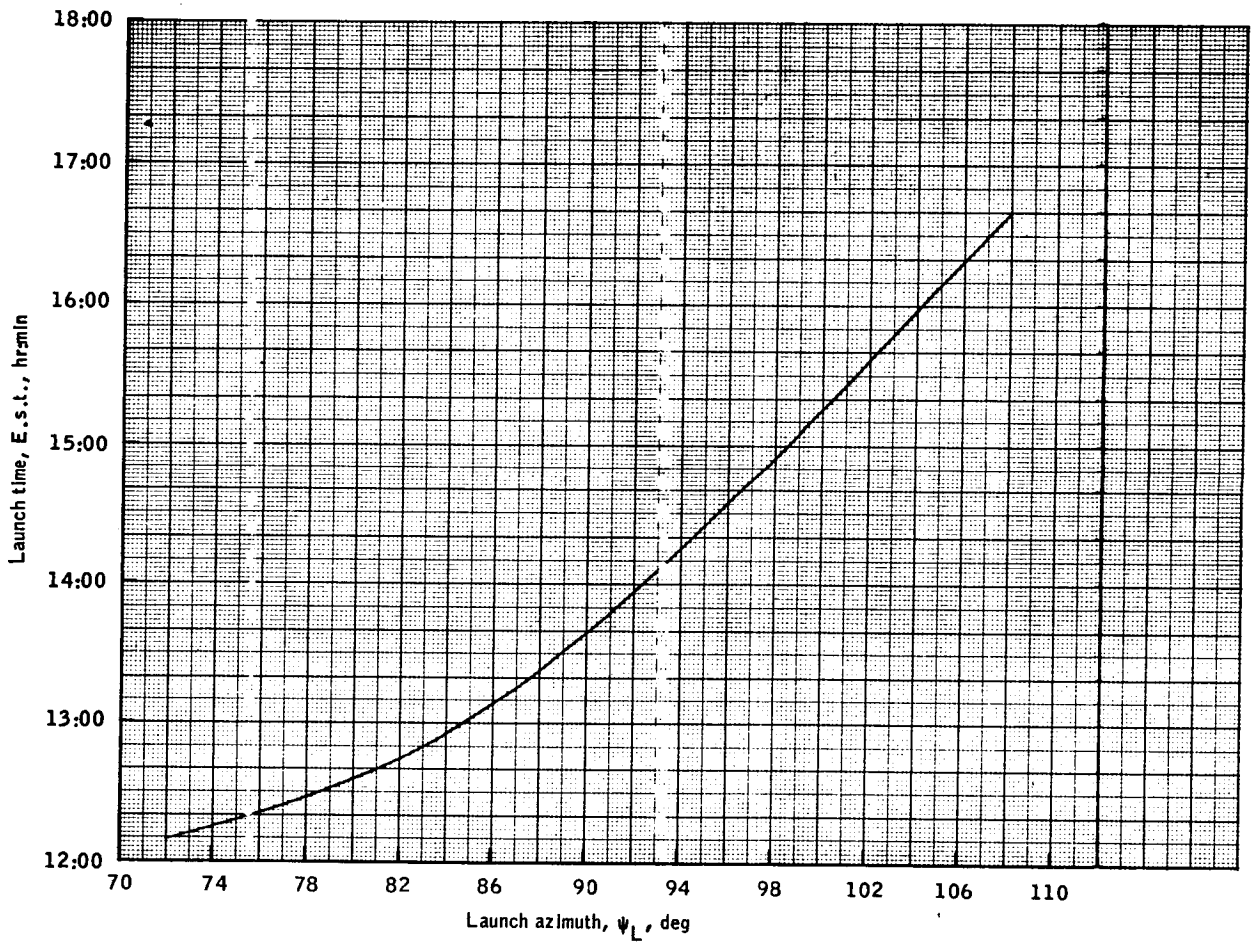
(mmm) June 4, 1968.

Figure 1.- Continued.



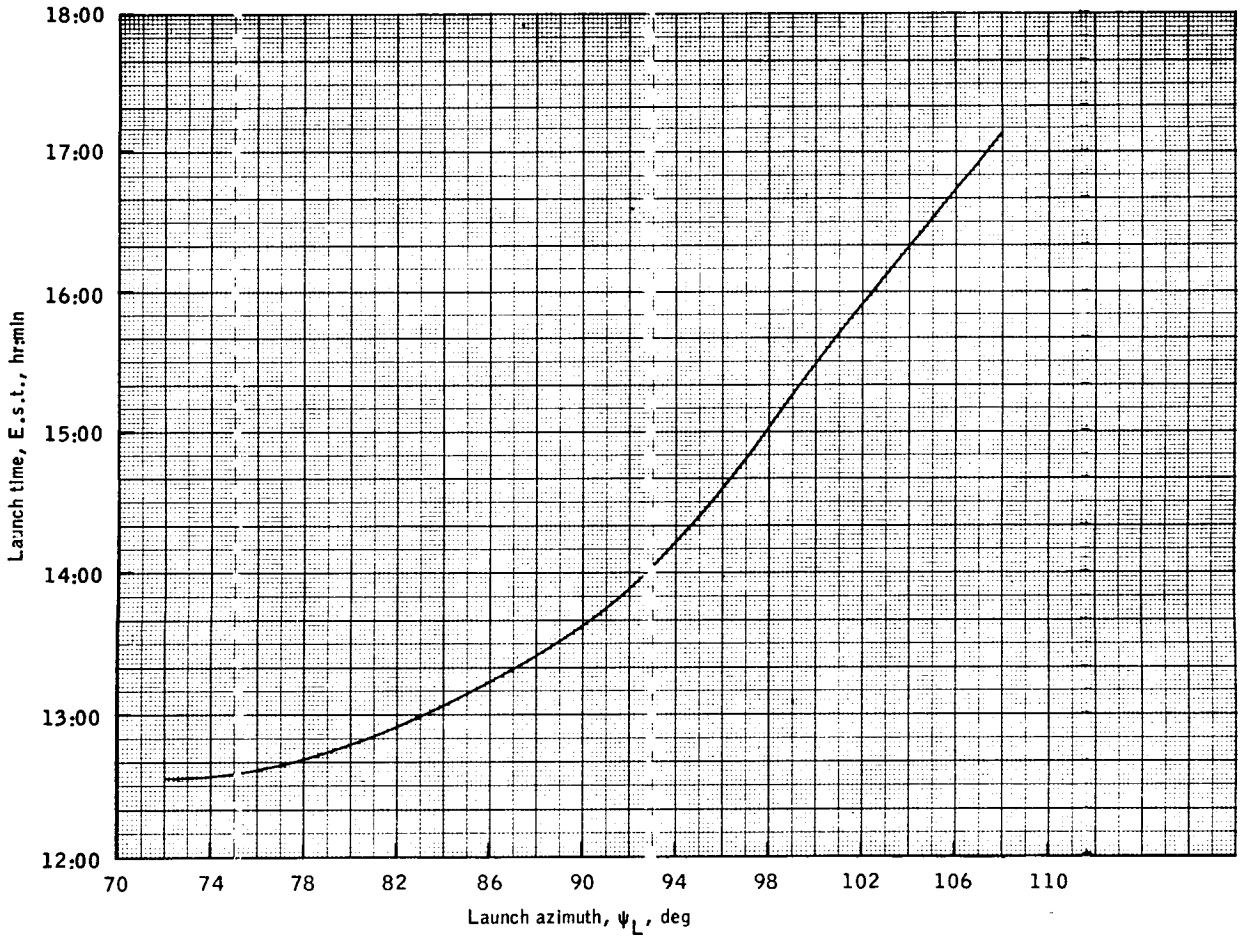
(nnn) June 5, 1963.

Figure 1.- Continued.



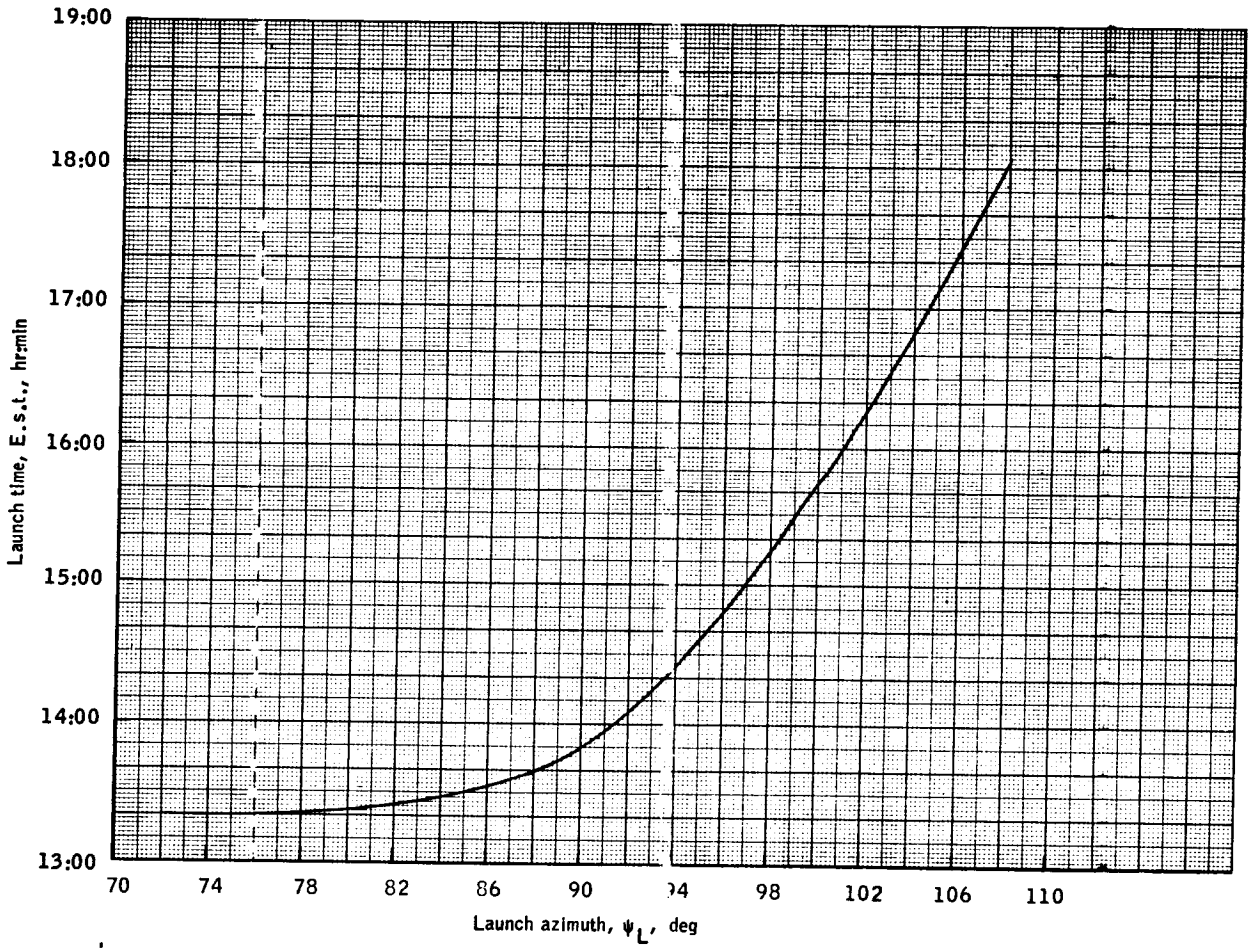
(ooo) June 6, 1966.

Figure 1.- Continued.



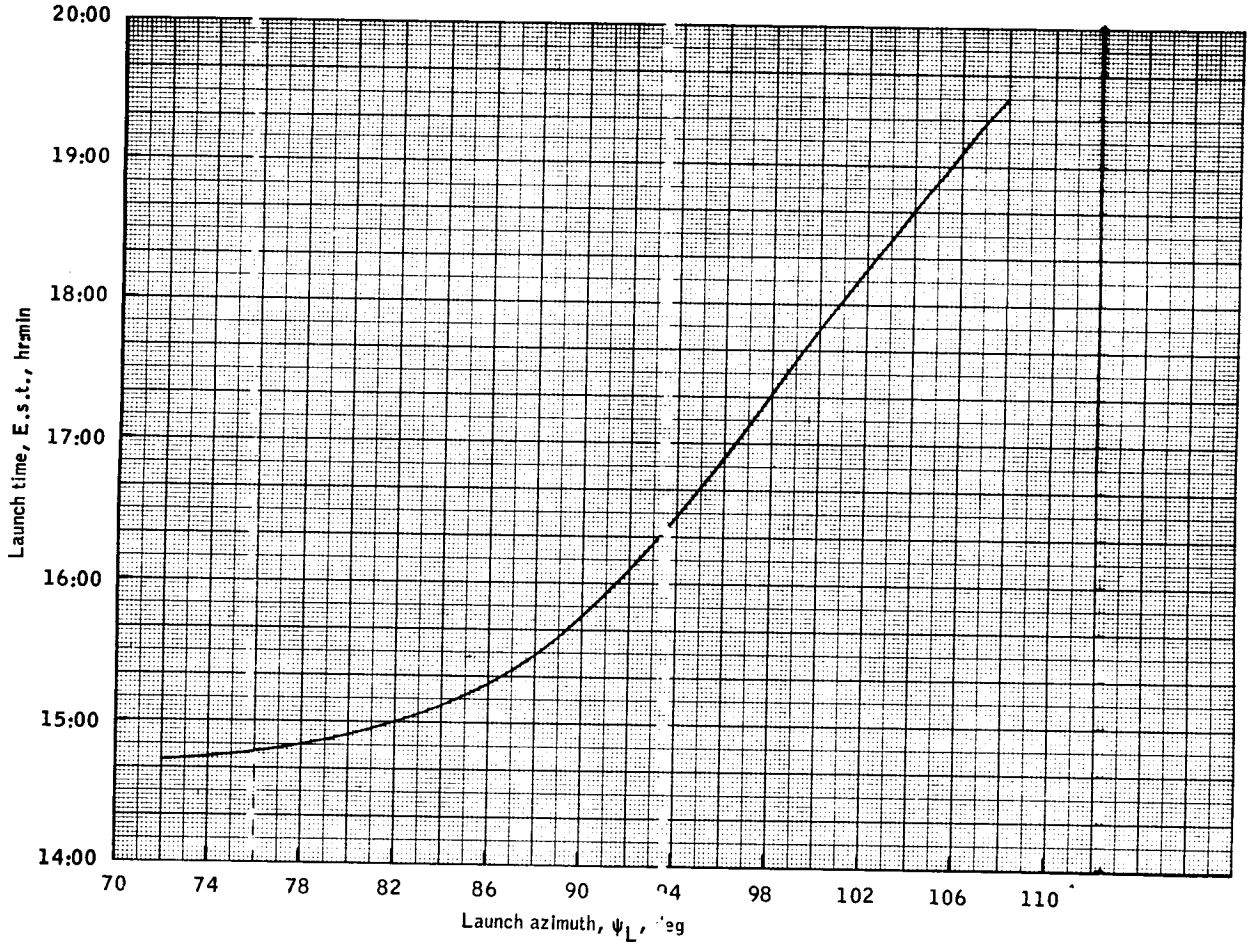
(ppp) June 7, 1968.

Figure 1.- Continued.



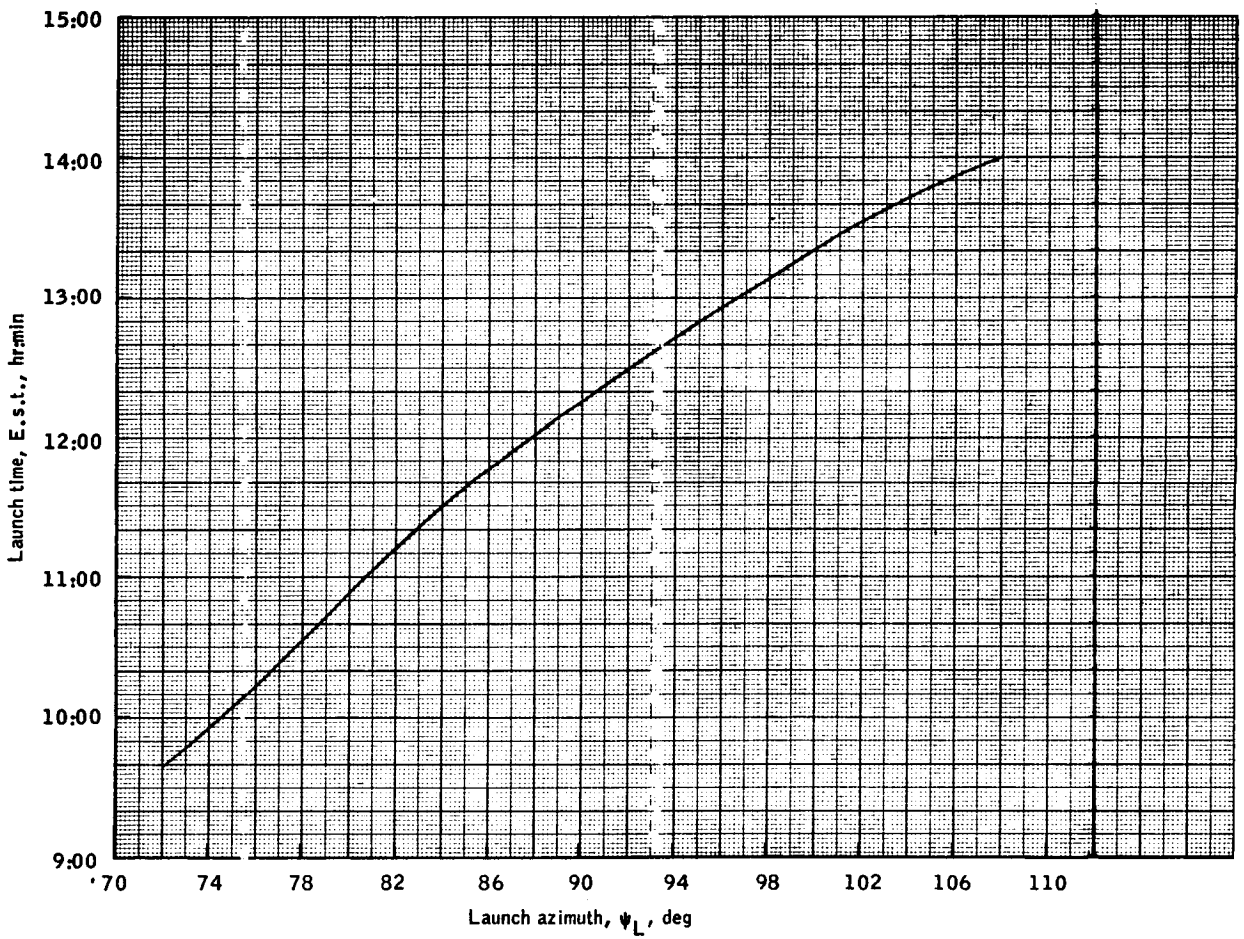
(qqq) June 8, 1968.

Figure 1.- Continued.



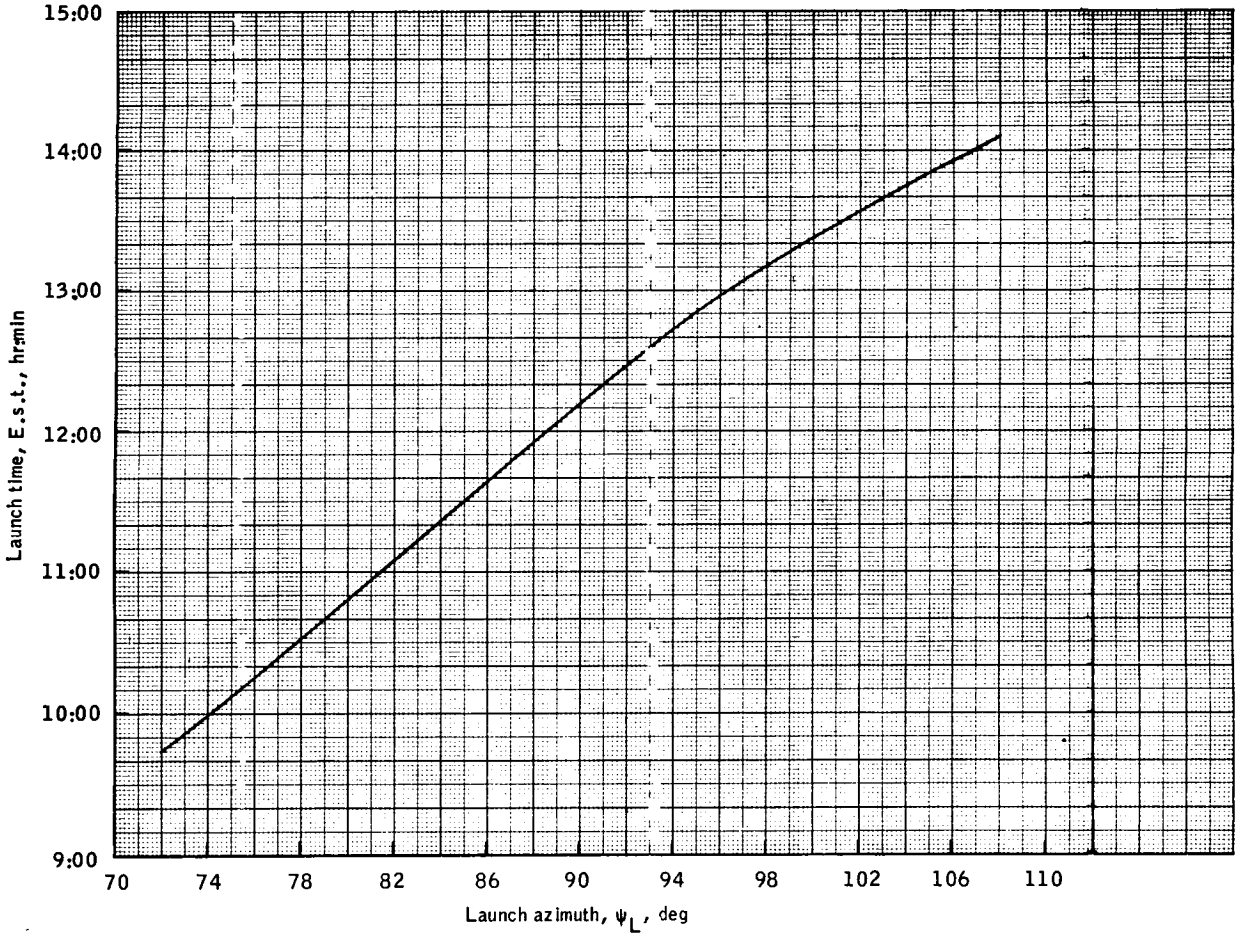
(rrr) June 9, 1968.

Figure 1.- Continued.



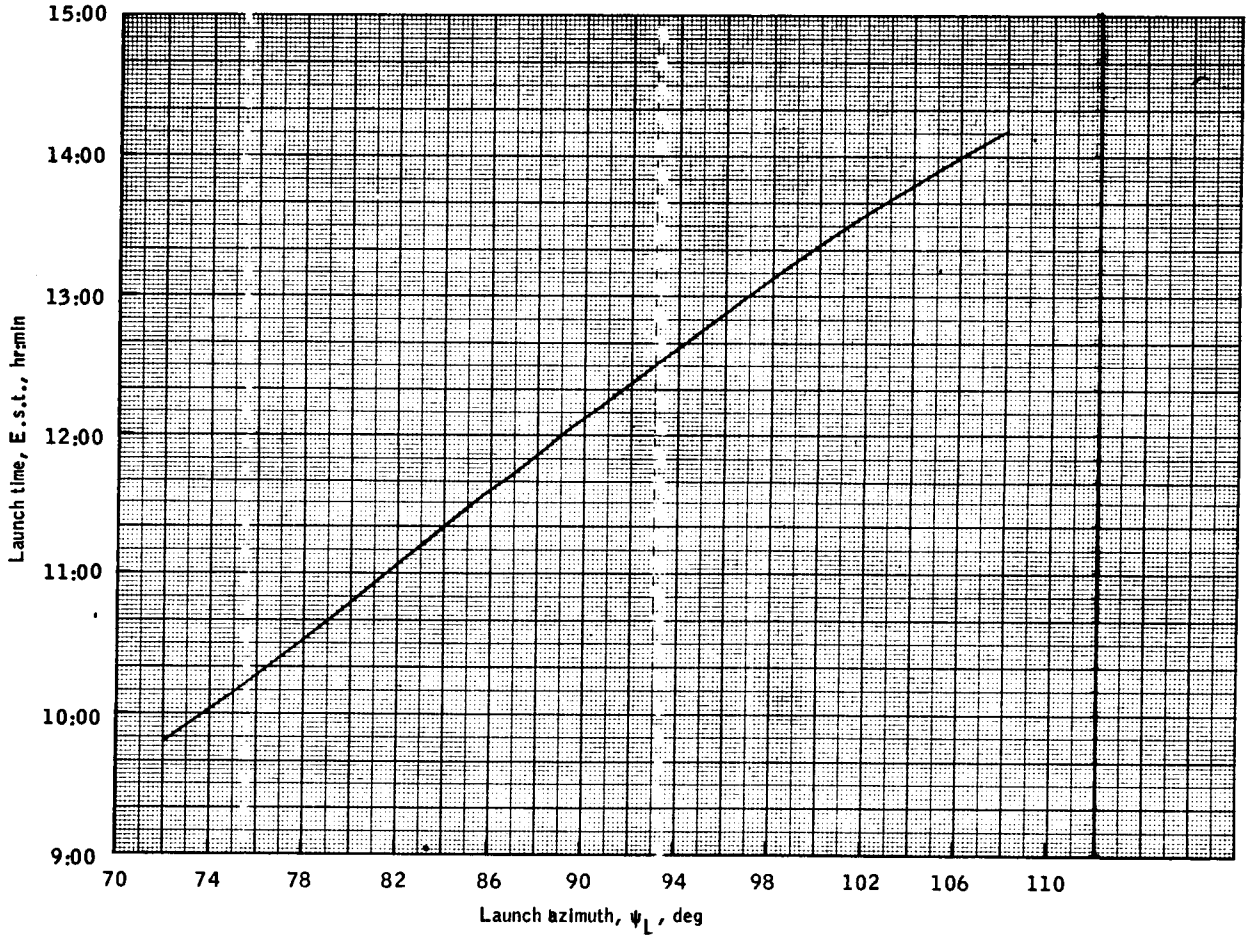
(sss) June 26, 1968.

Figure 1.- Continued.



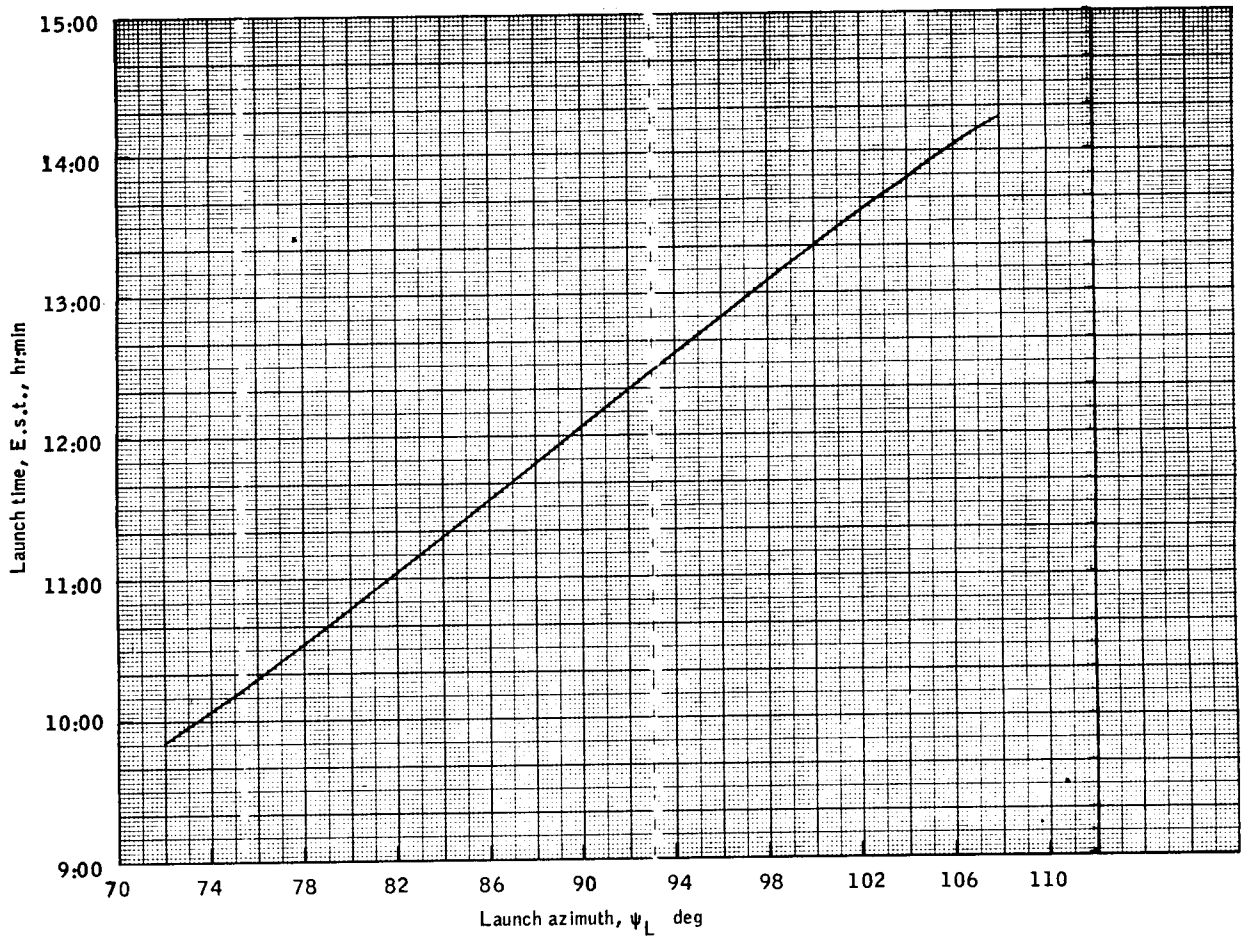
(ttt) June 27, 1963.

Figure 1.- Continued.



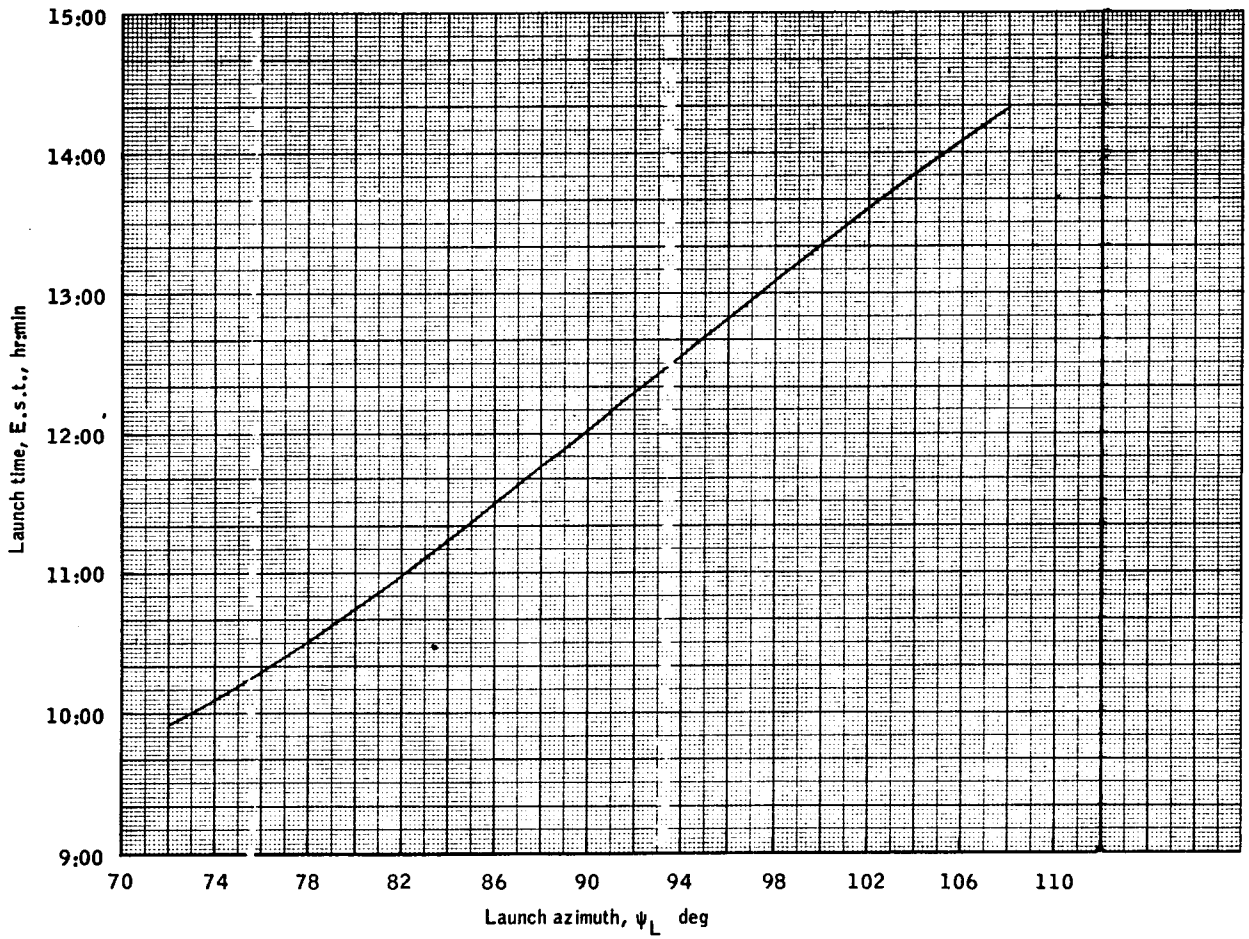
(uuu) June 28, 1968.

Figure 1.- Continued.



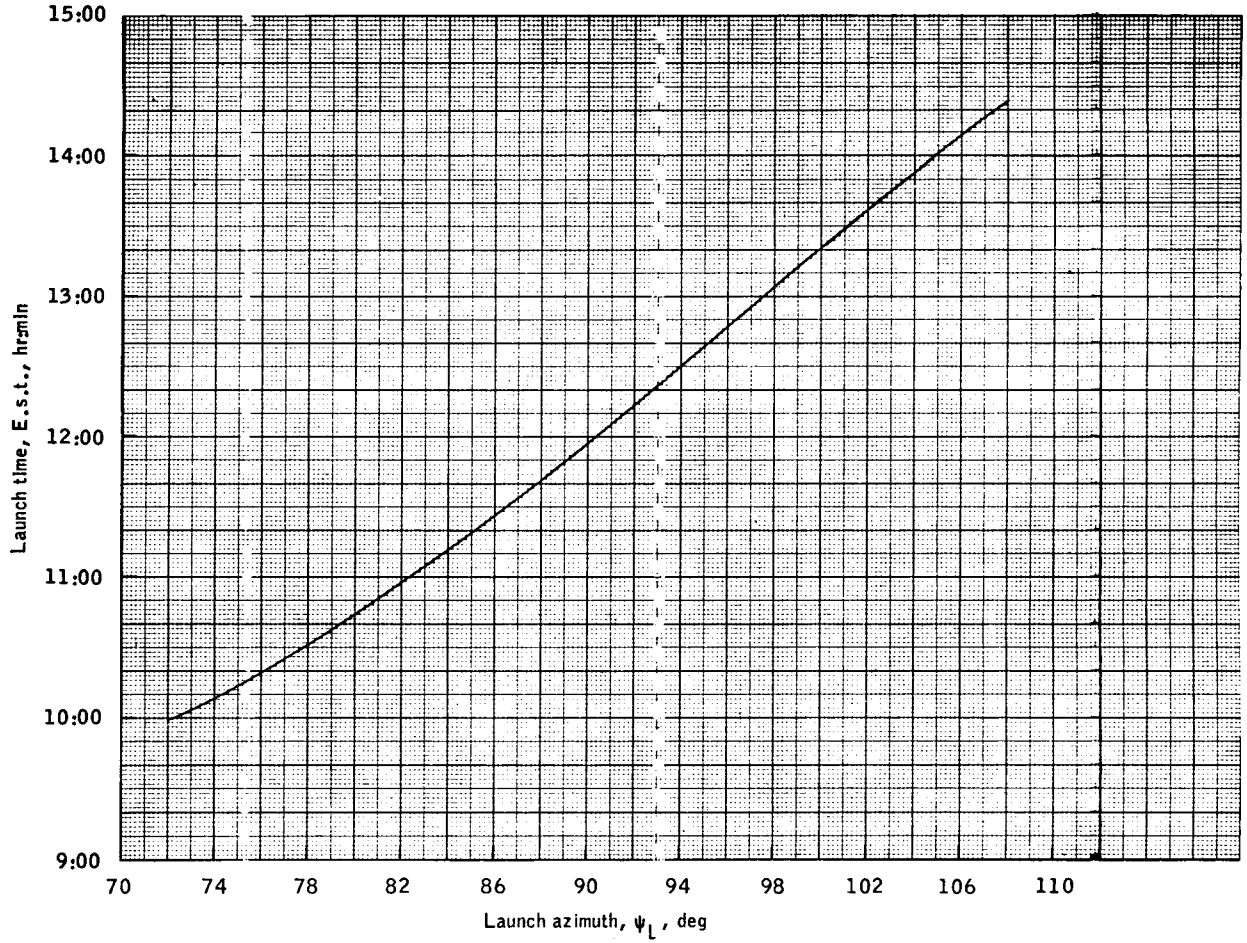
(vvv) June 29, 1968.

Figure 1.- Continued.



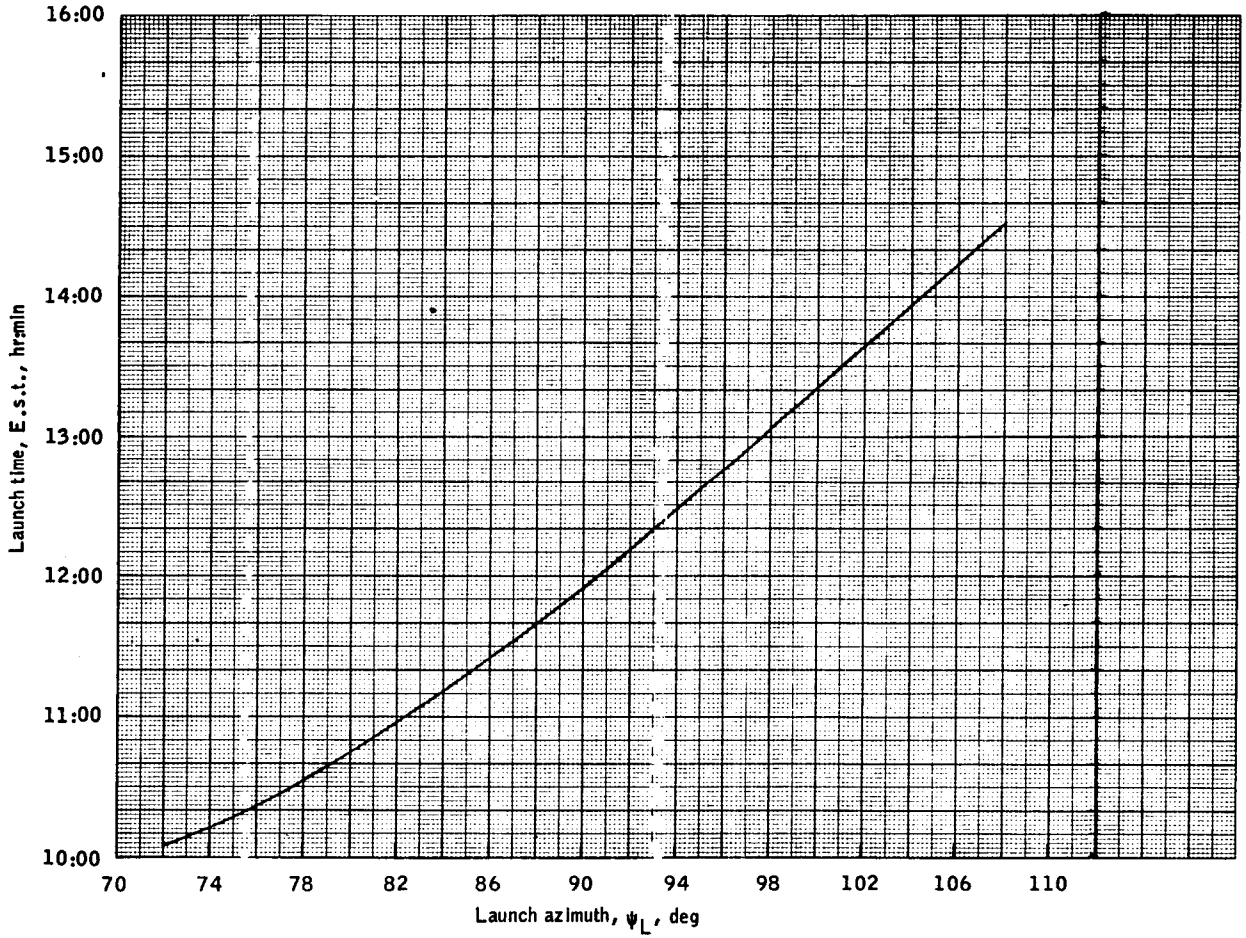
(www) June 30, 1968.

Figure 1.- Continu d.



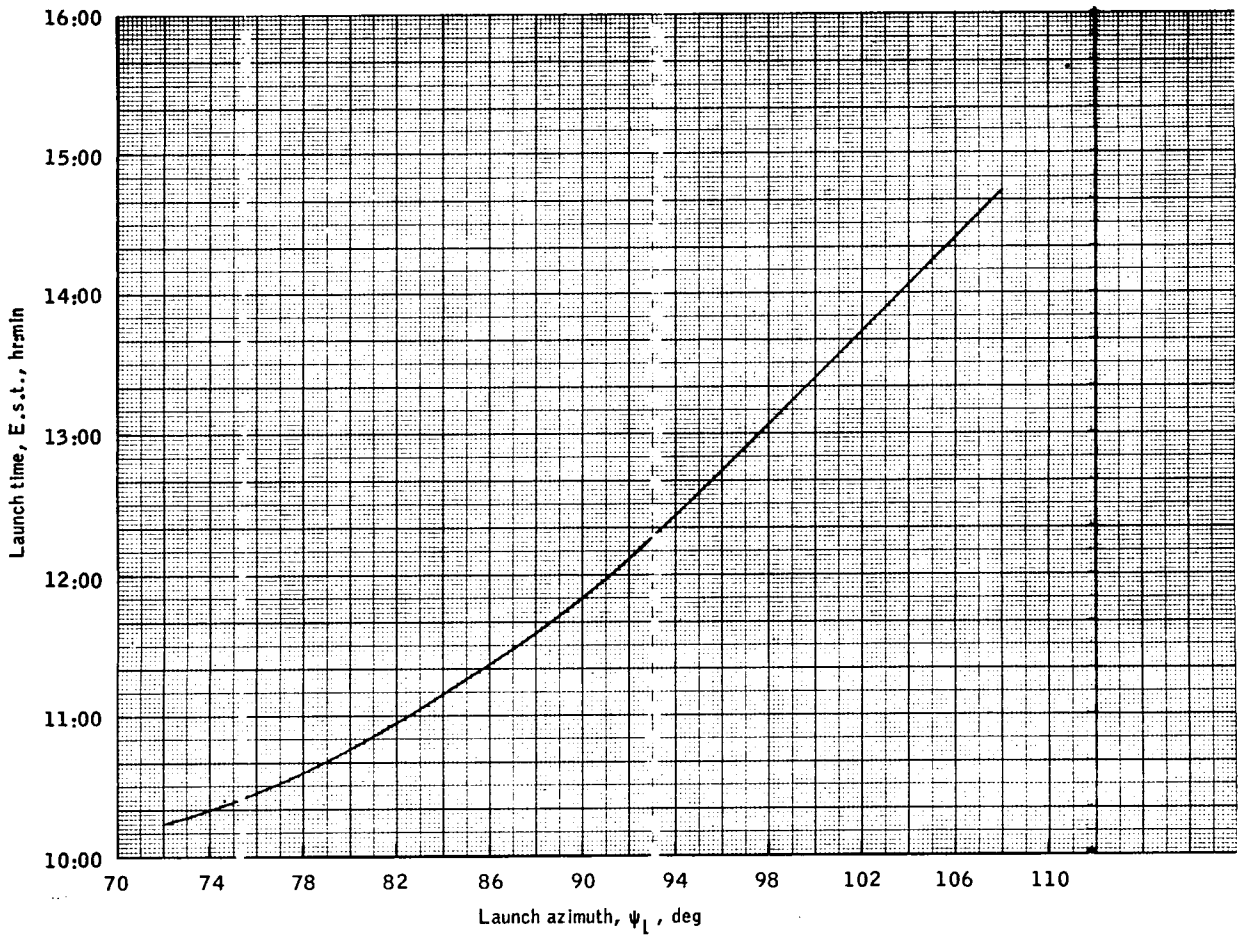
(xxx) July 1, 1968.

Figure 1.- Continued.



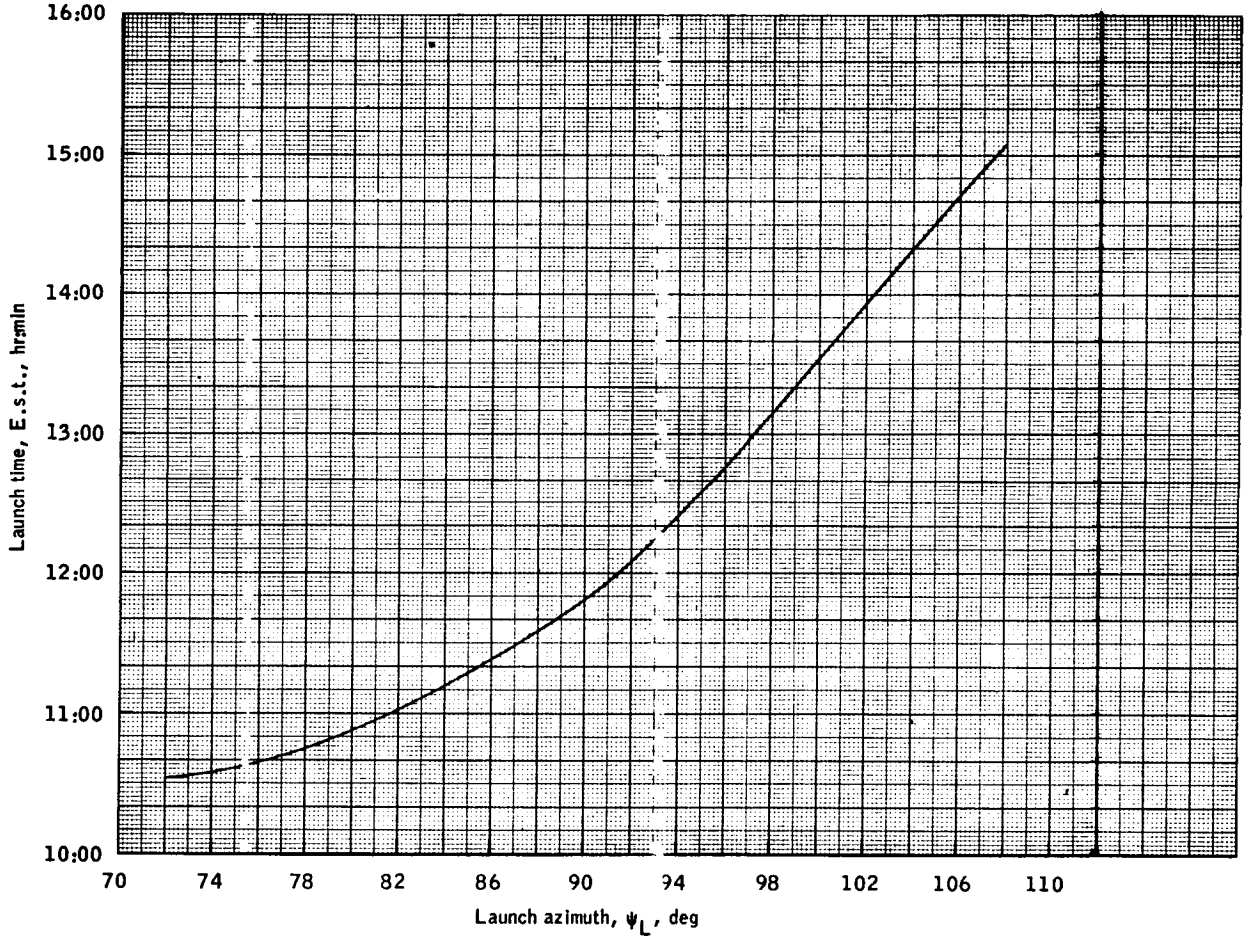
(yyy) July 2, 1968.

Figure 1.- Continued.



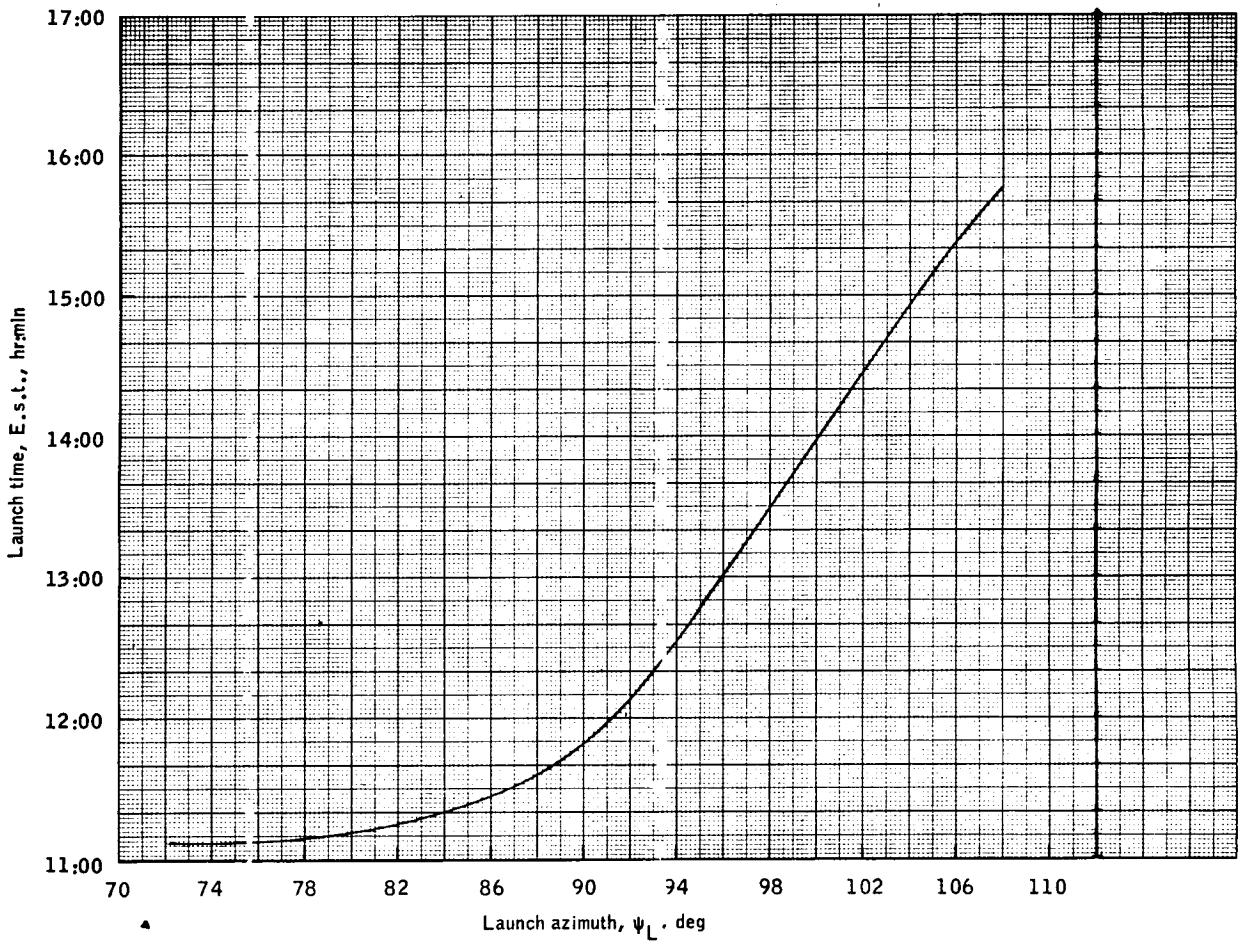
(zzz) July 3, 1968.

Figure 1. - Continued.



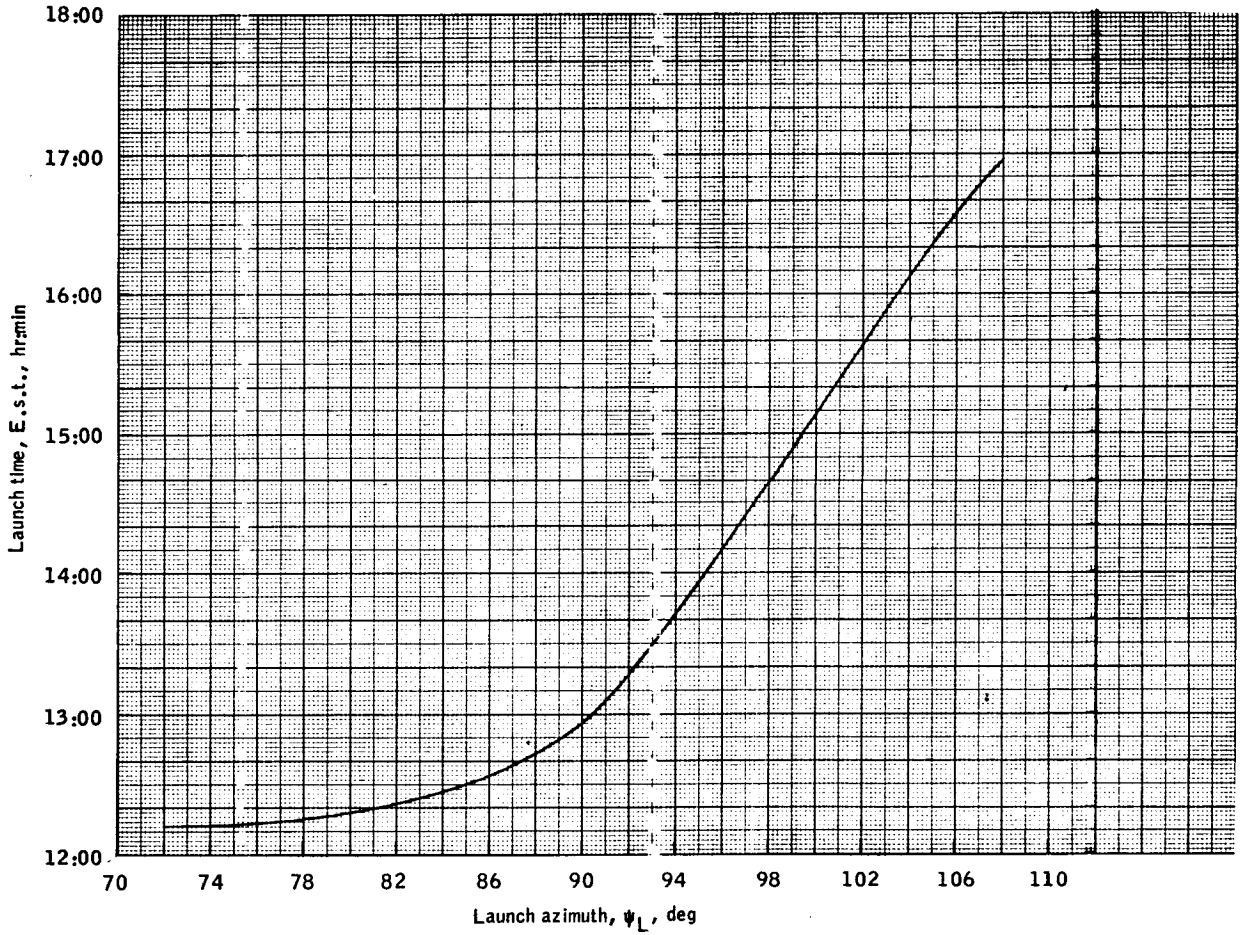
(aaaa) July 4, 1968.

Figure 1. - Continued.



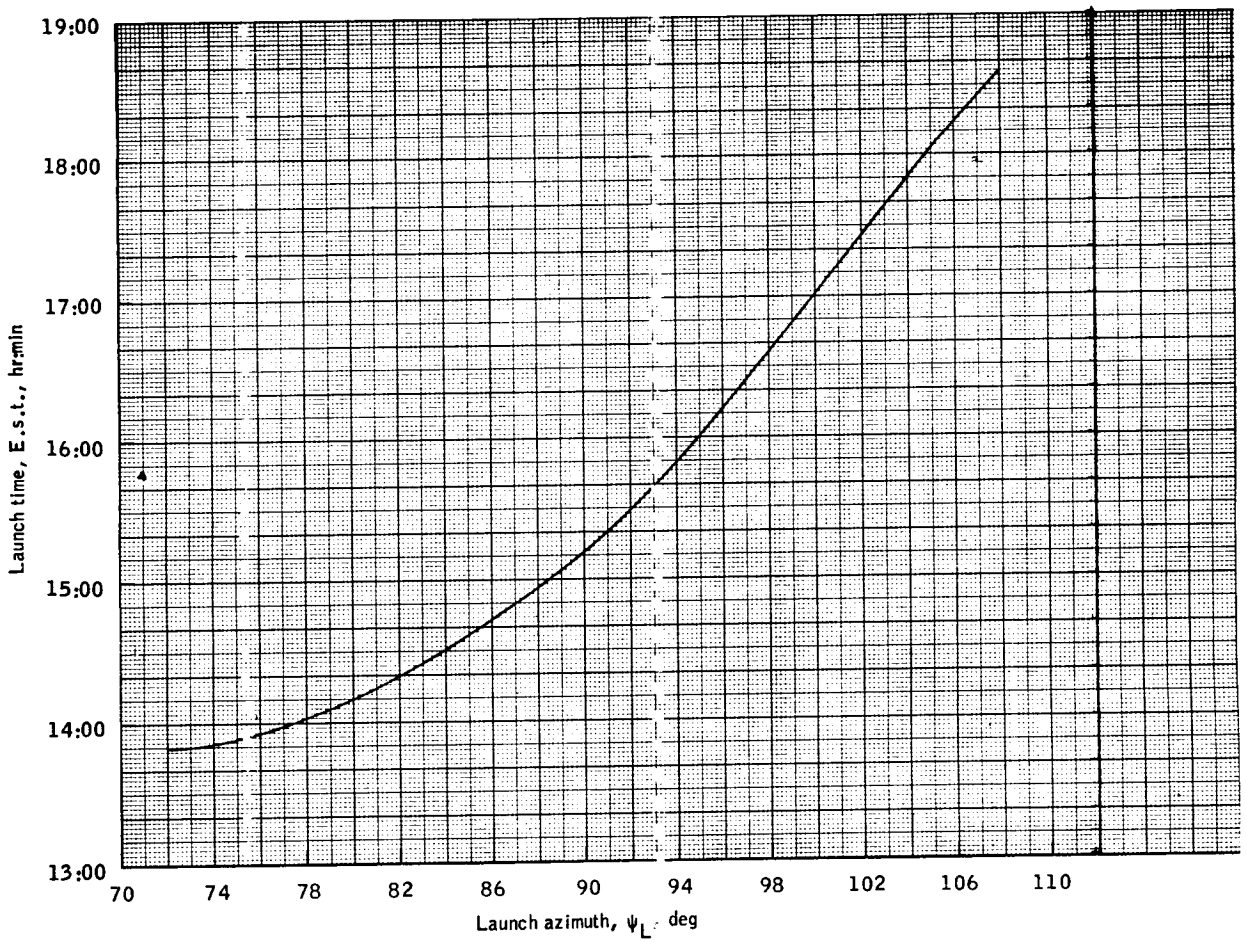
(bbbb) July 5, 1968.

Figure 1.- Continued.



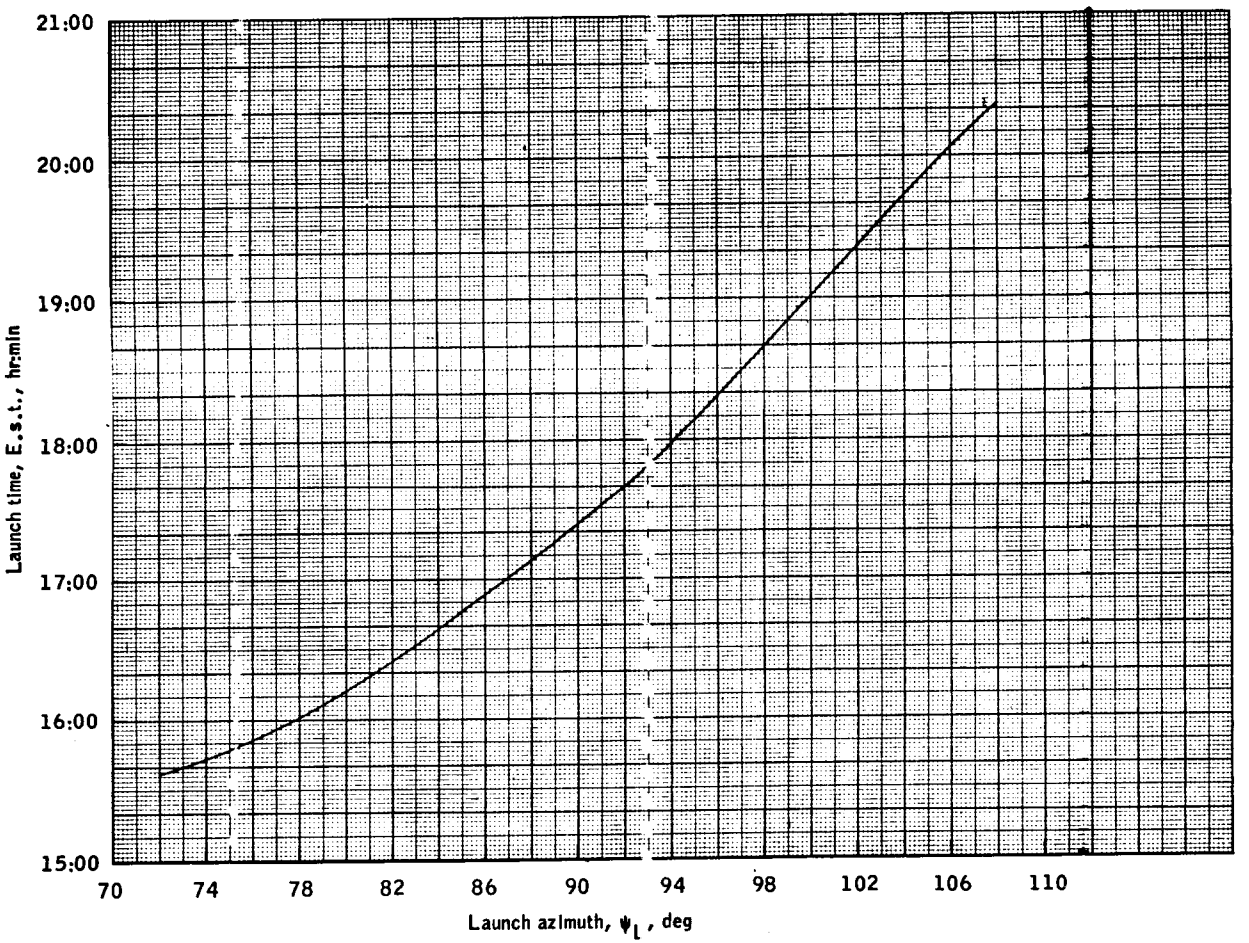
(cccc) July 6, 1968.

Figure 1. - Continued.



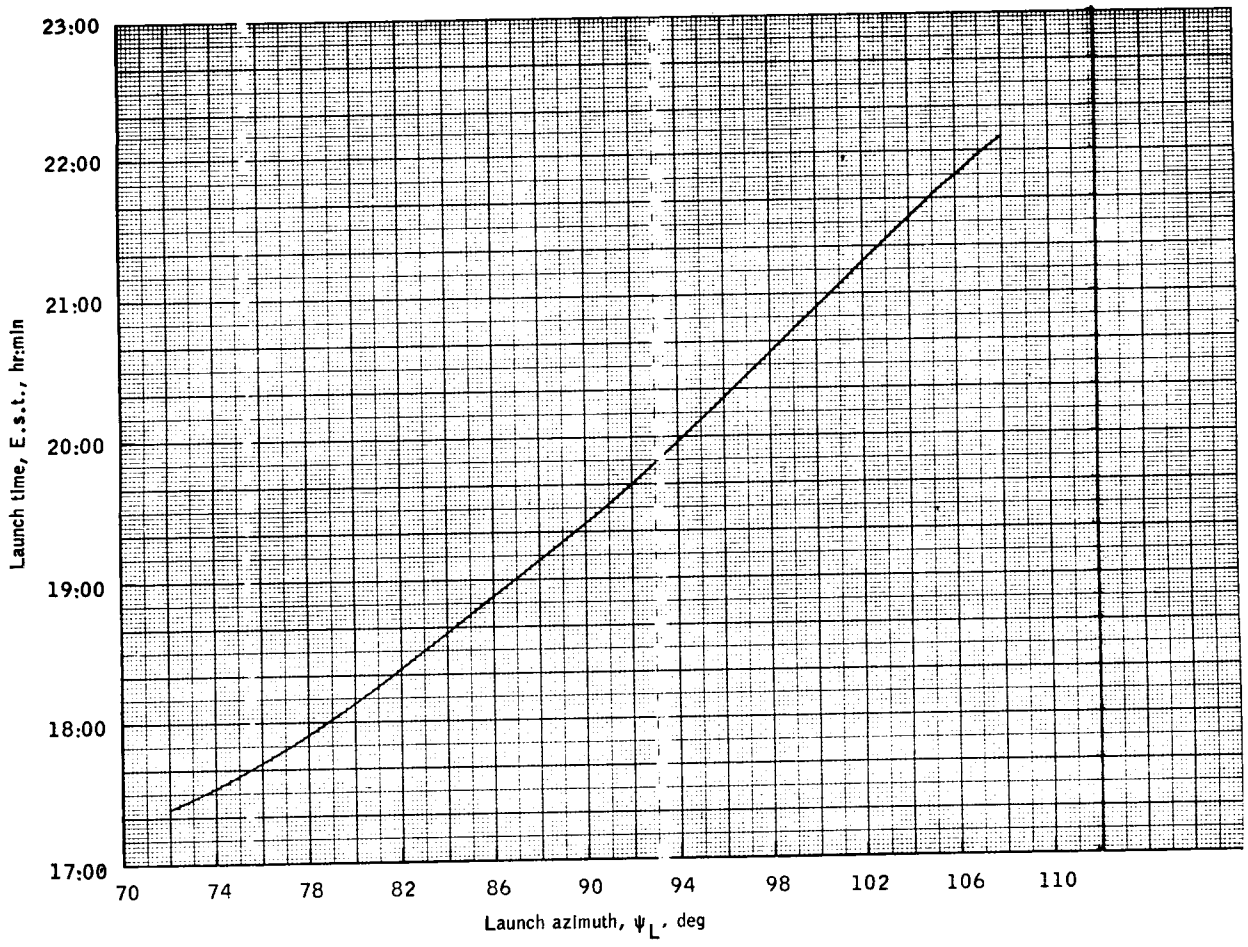
(dddd) July 7, 1963.

Figure 1. - Continued.



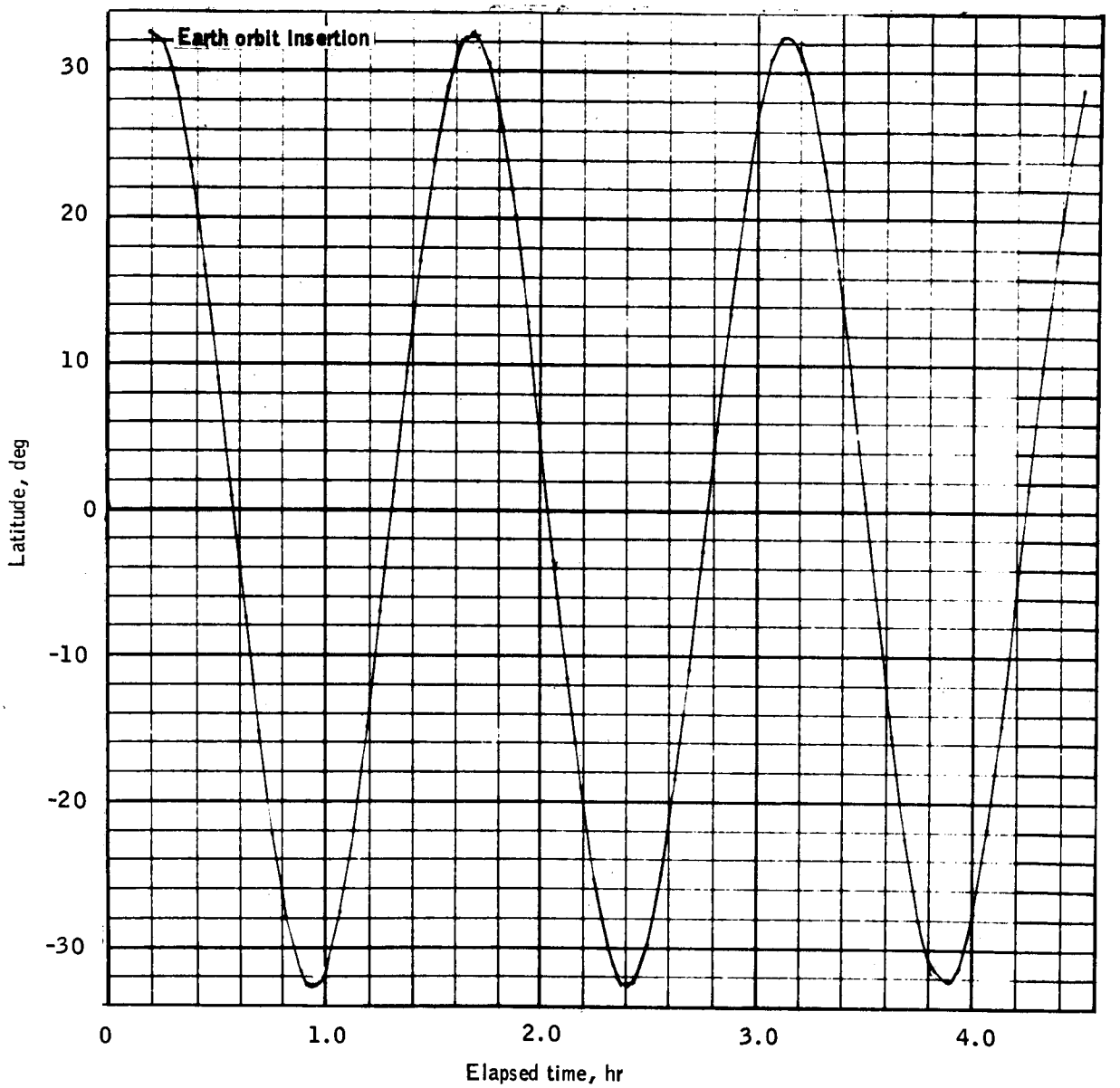
(eeee) July 8, 1968.

Figure 1.- Continued.



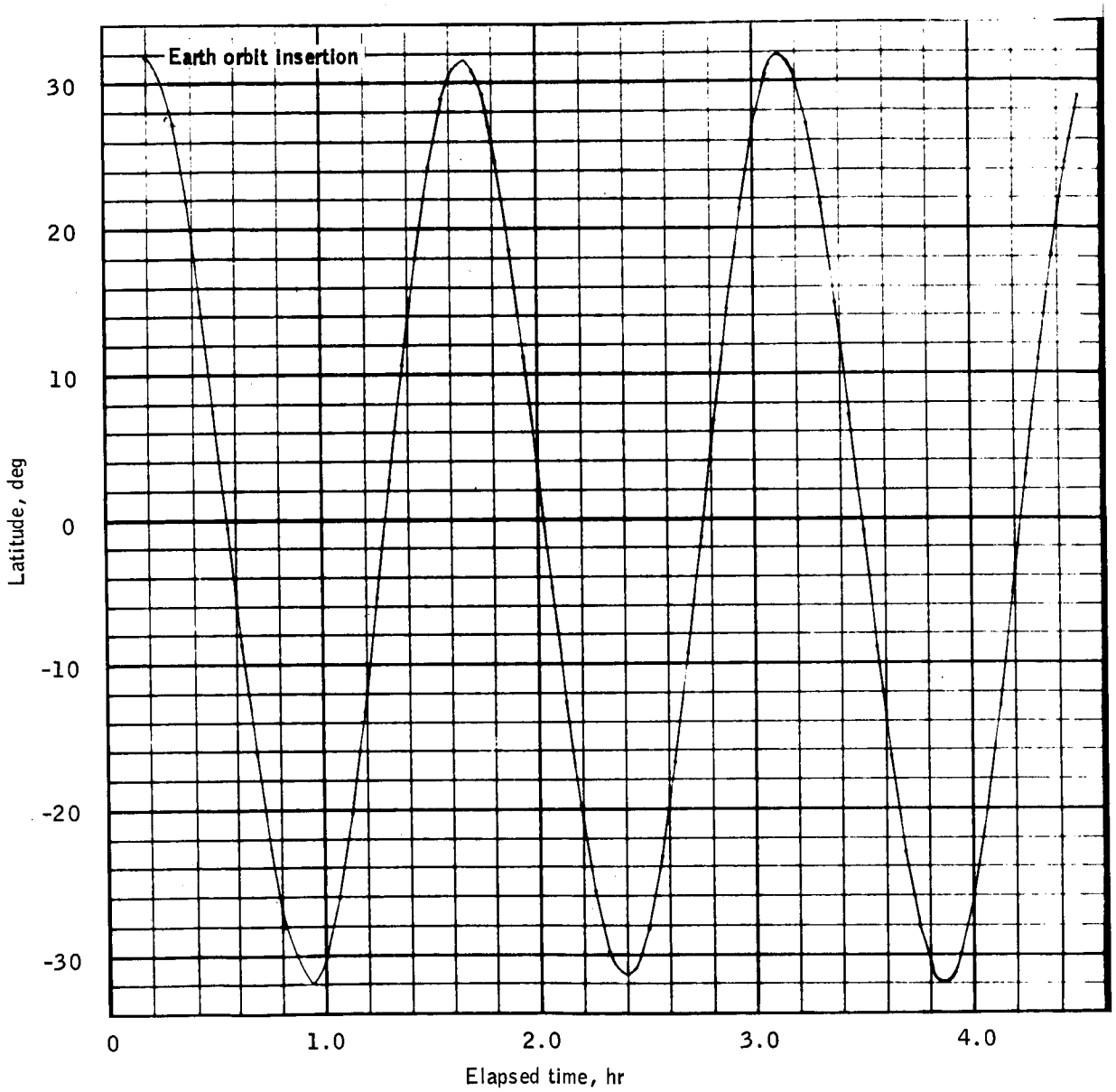
(ffff) July 9, 1968

Figure 1.- Concluded.



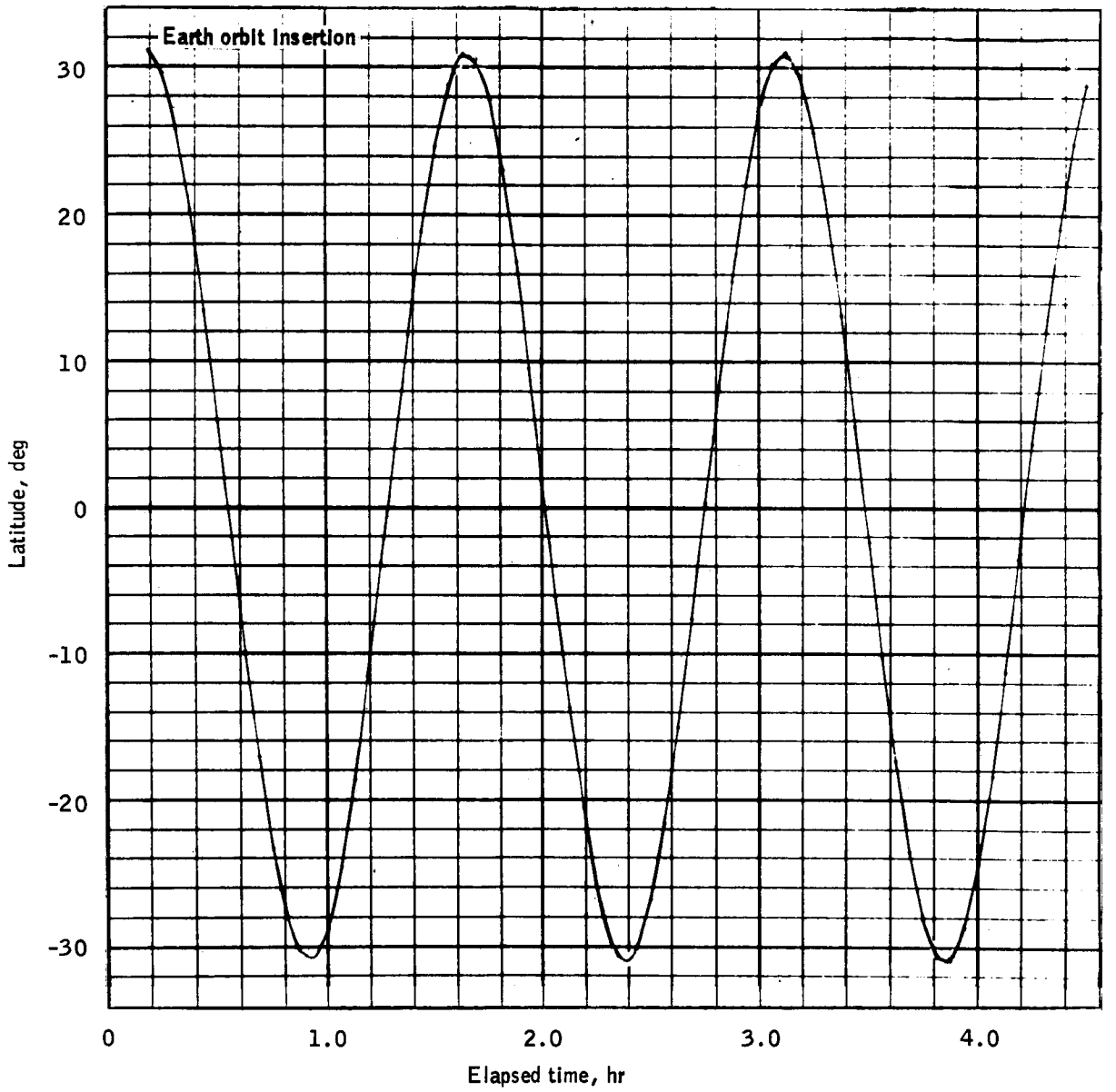
(a) 72 degree launch azimuth.

Figure 2.- Elapsed time from launch versus latitude for launch azimuth 72° through 108°, (100 nautical mile altitude earth parking orbit).



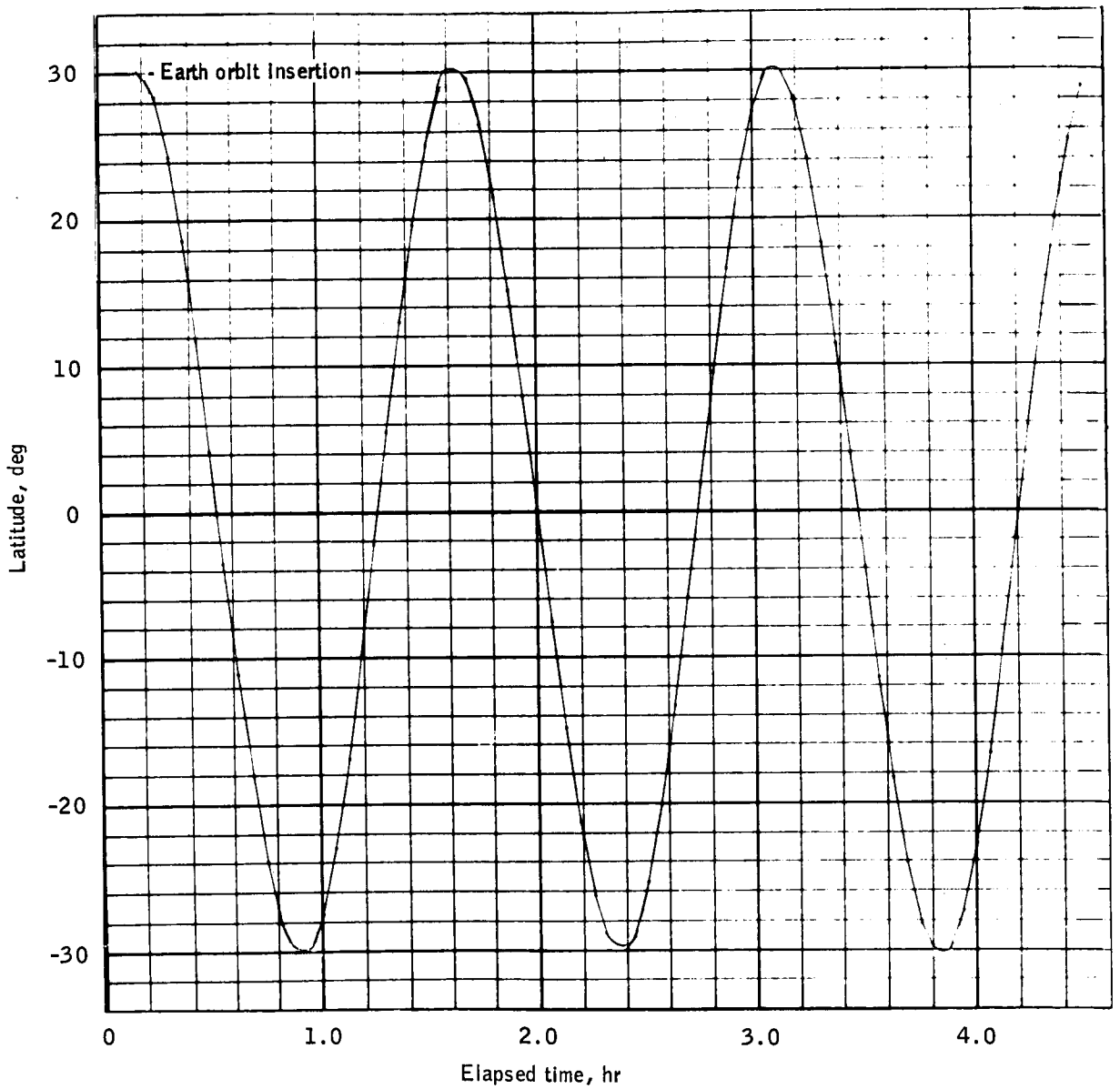
(b) 74 degree launch azimuth.

Figure 2.- Continued.



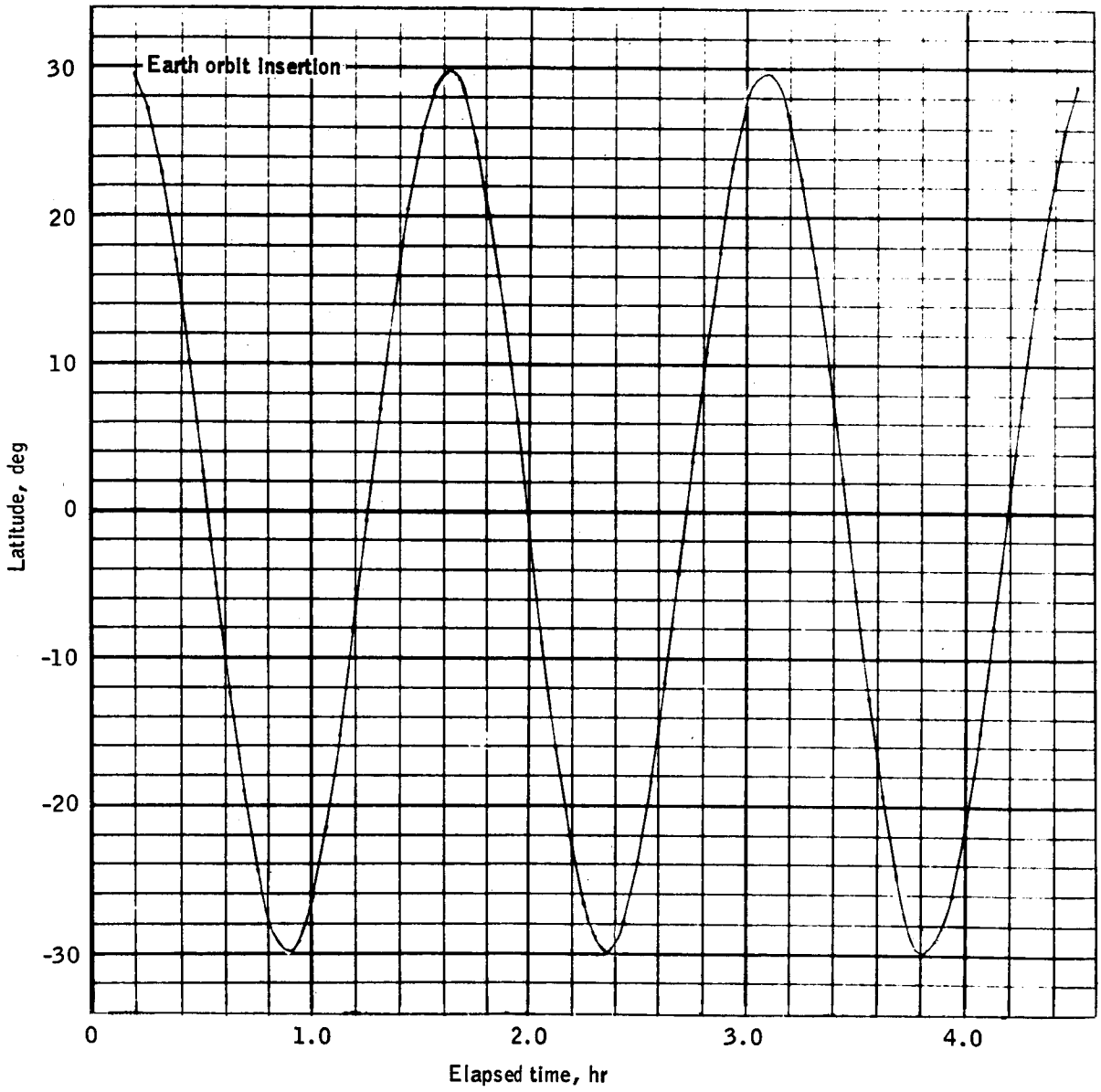
(c) 76 degree launch azimuth.

Figure 2.- Continued.



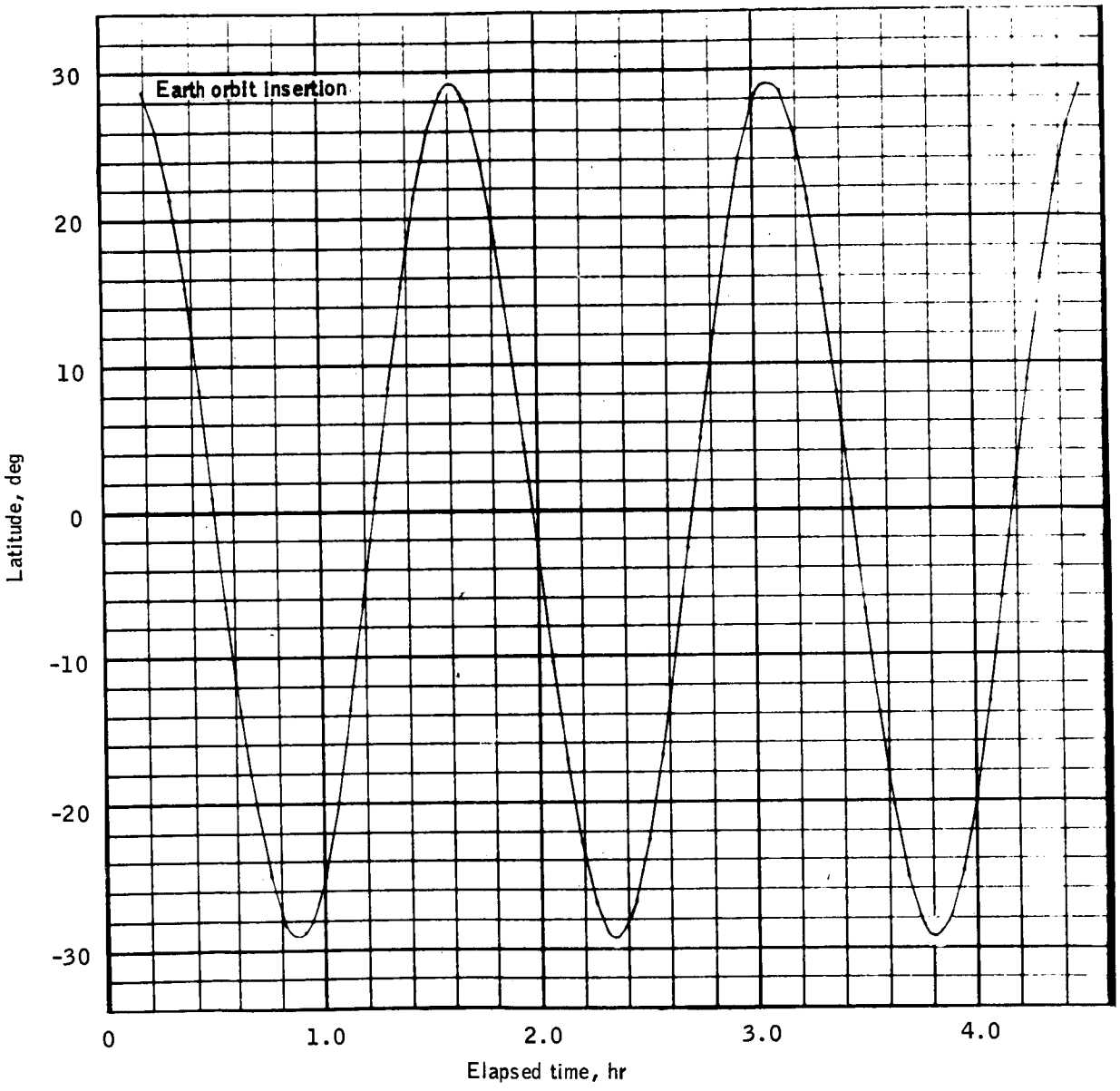
(d) 78 degree launch azimuth.

Figure 2.- Continued.



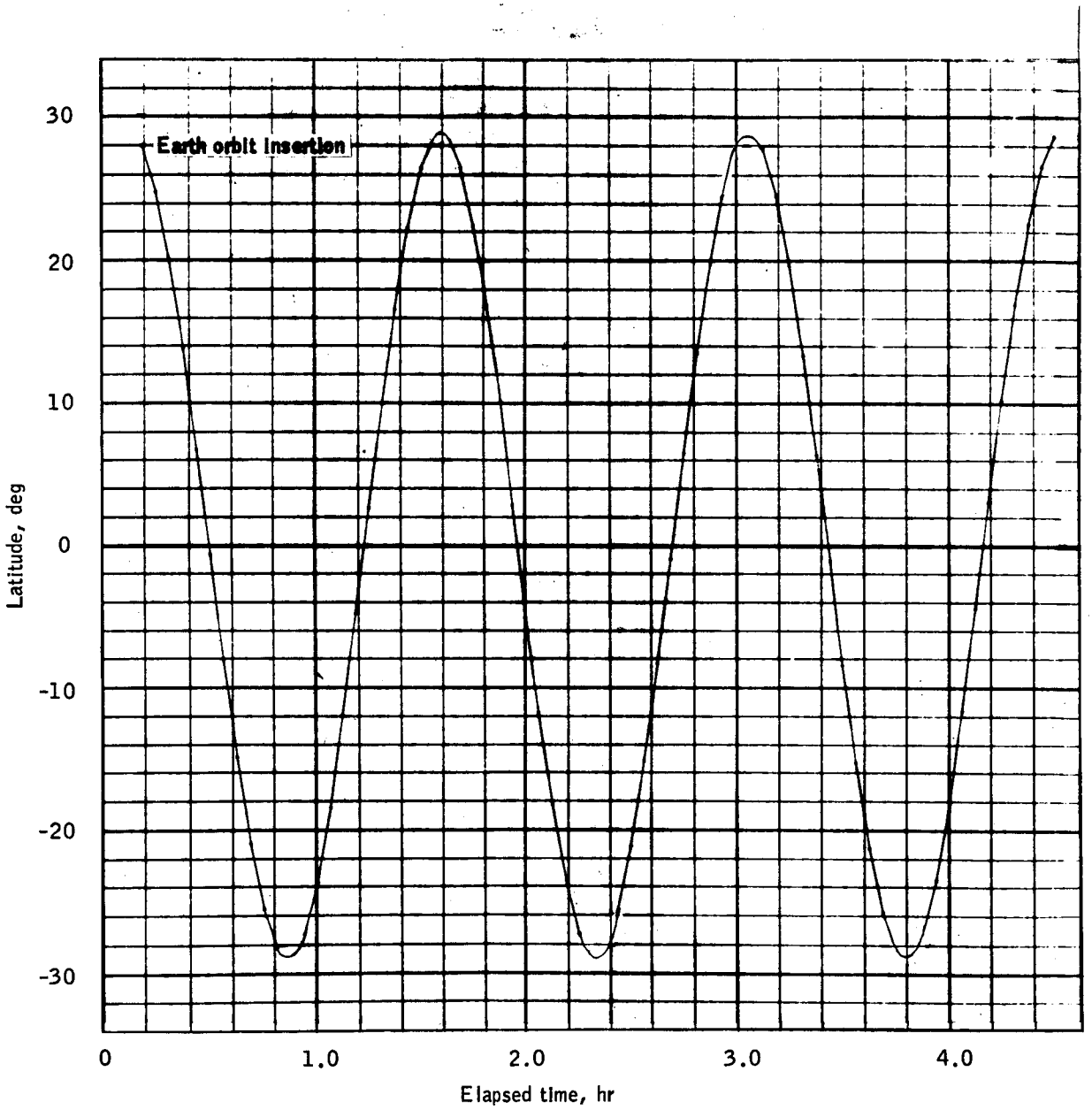
(e) 80 degree launch azimuth.

Figure 2.- Continued.



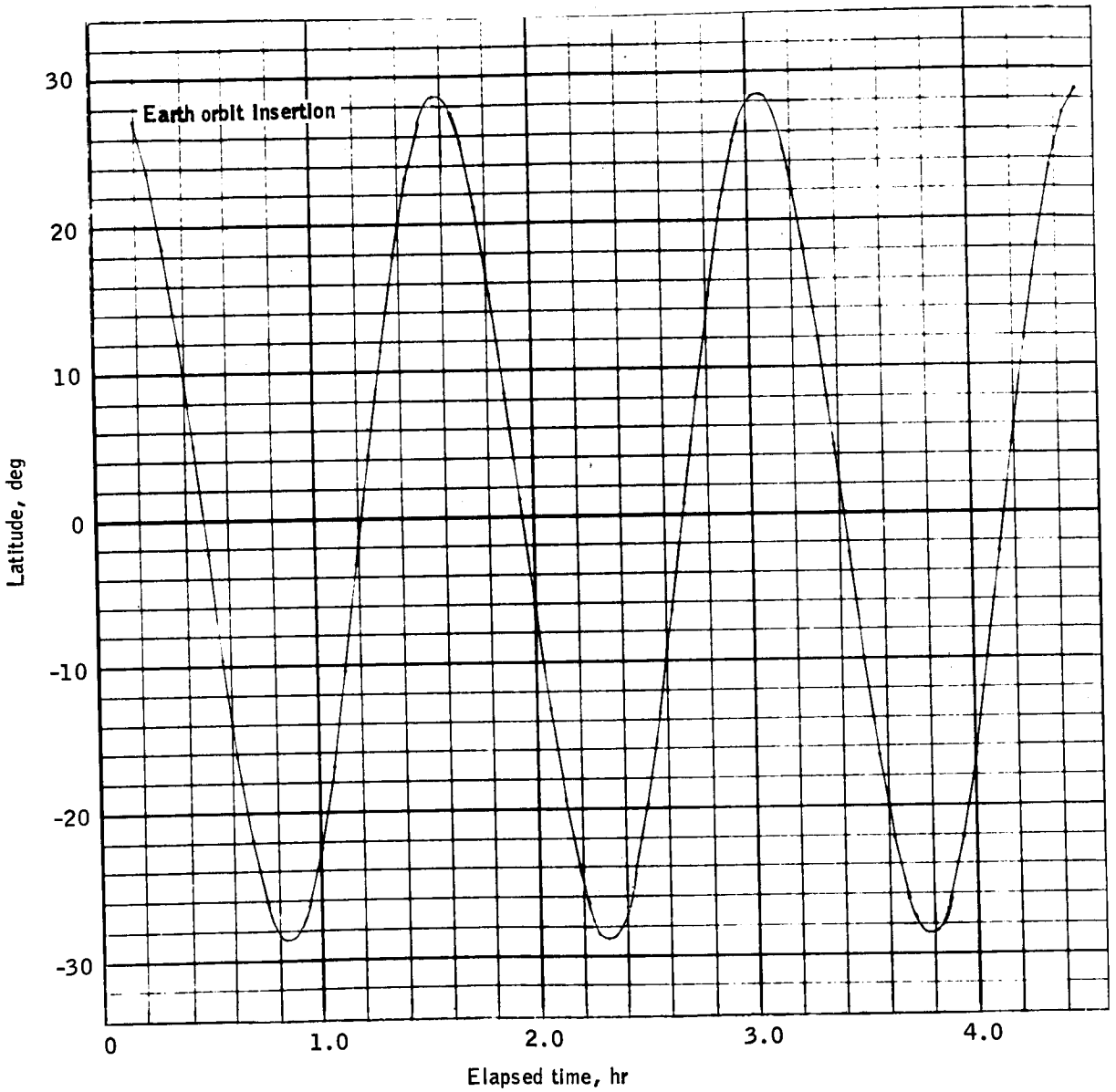
(f) 82 degree launch azimuth.

Figure 2.- Continued.



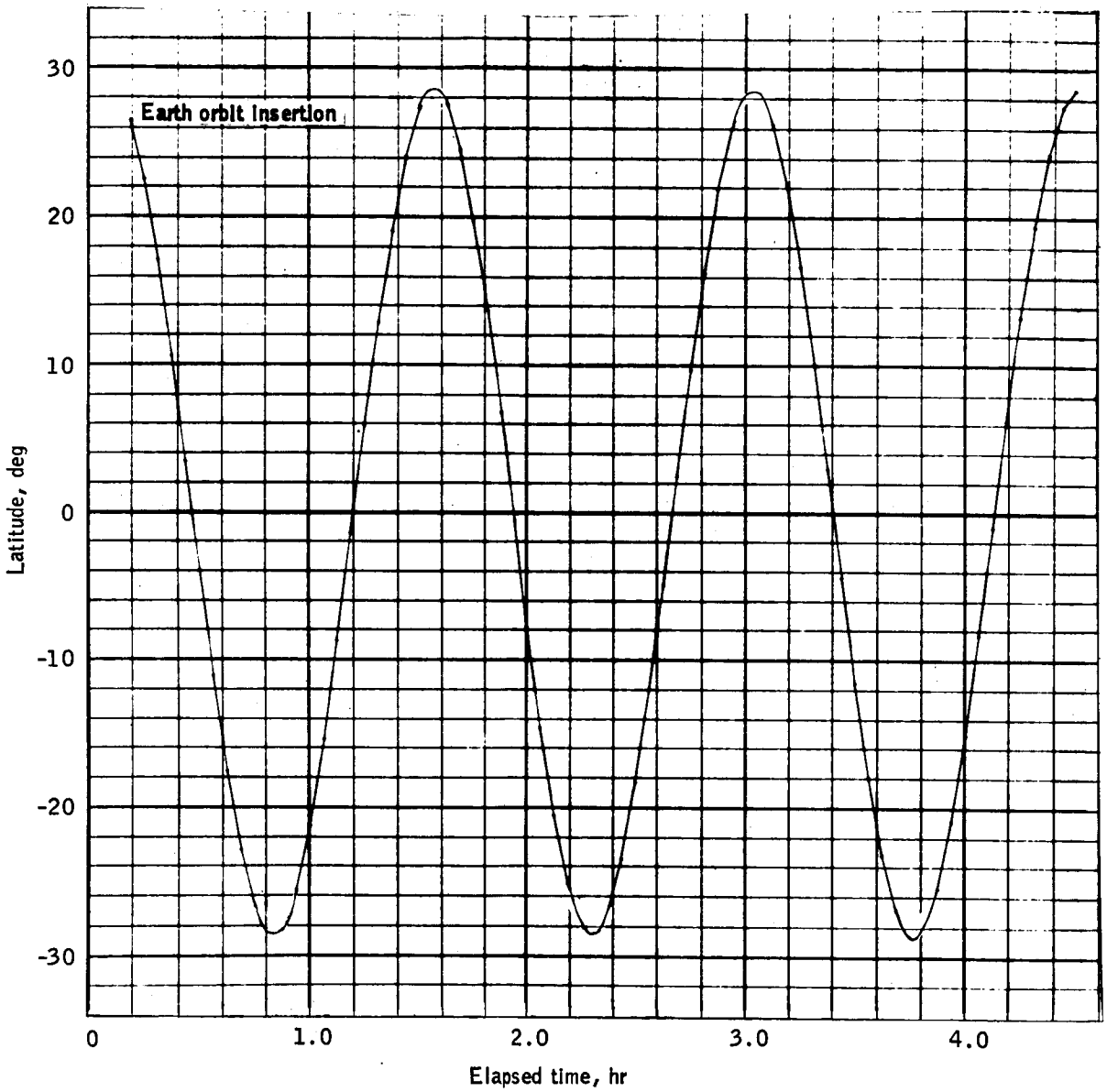
(g) 84 degree launch azimuth.

Figure 2.- Continued.



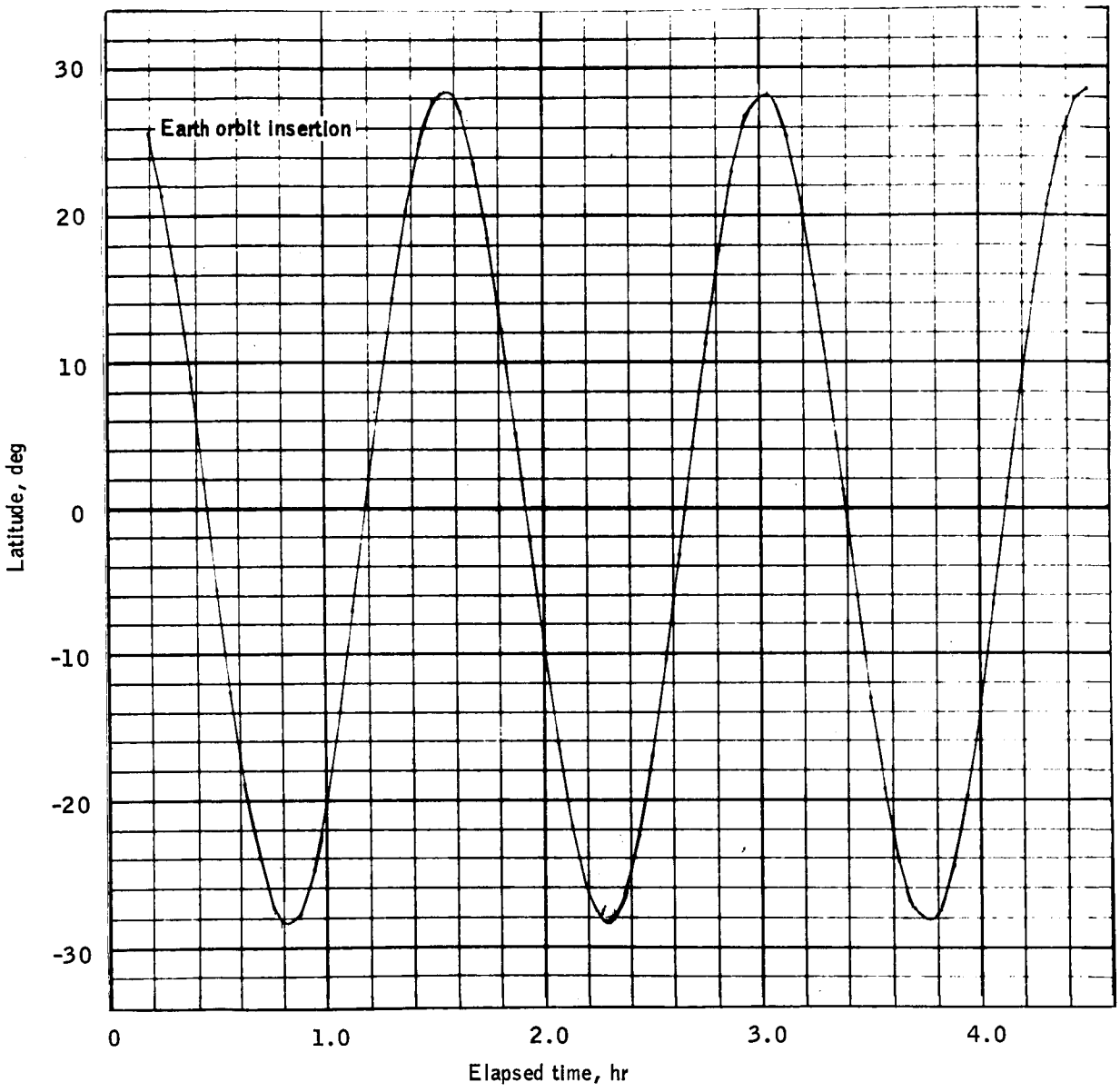
(h) 86 degree launch azimuth.

Figure 2.- Continued.



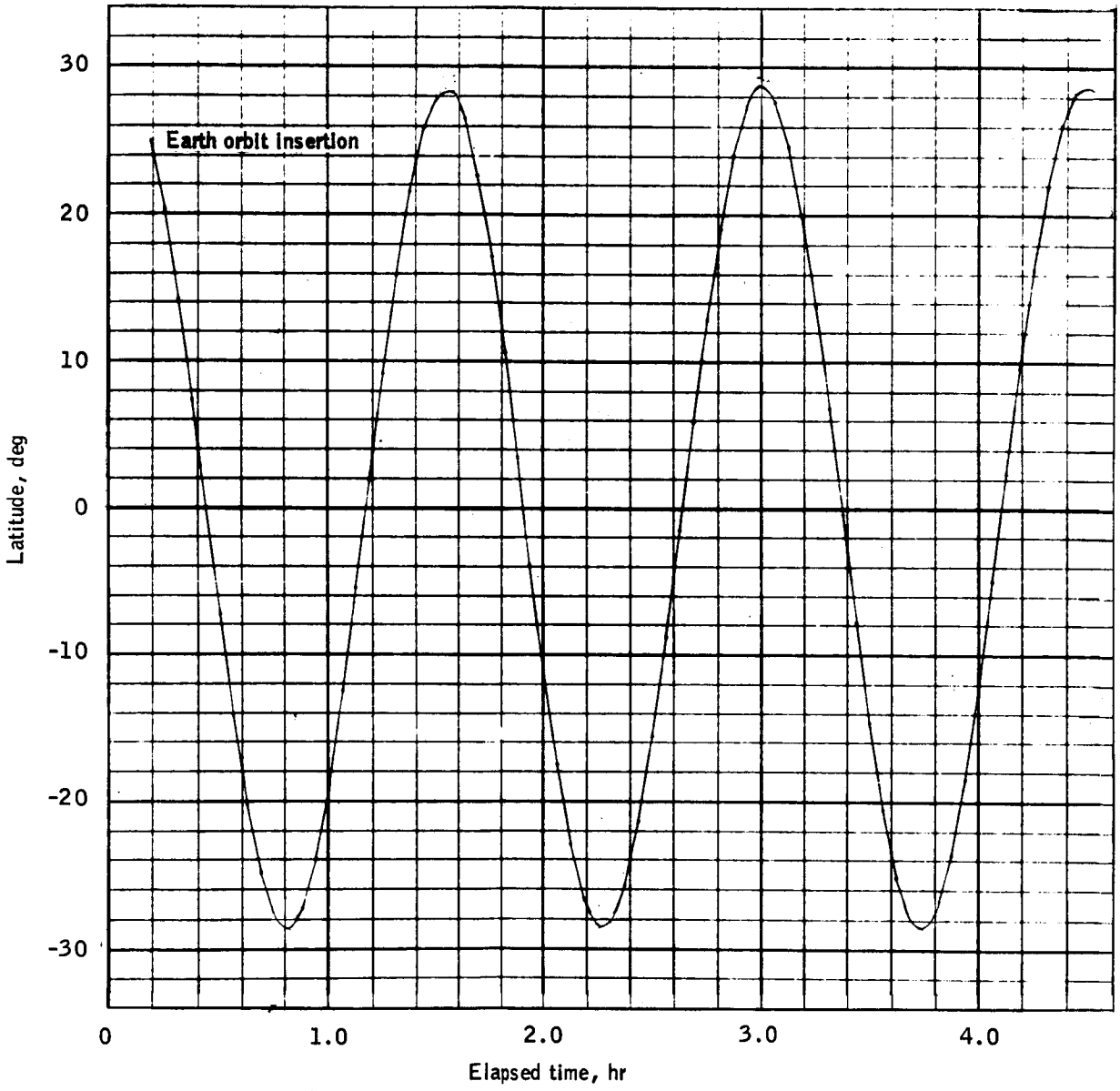
(l) 88 degree launch azimuth.

Figure 2.- Continued.



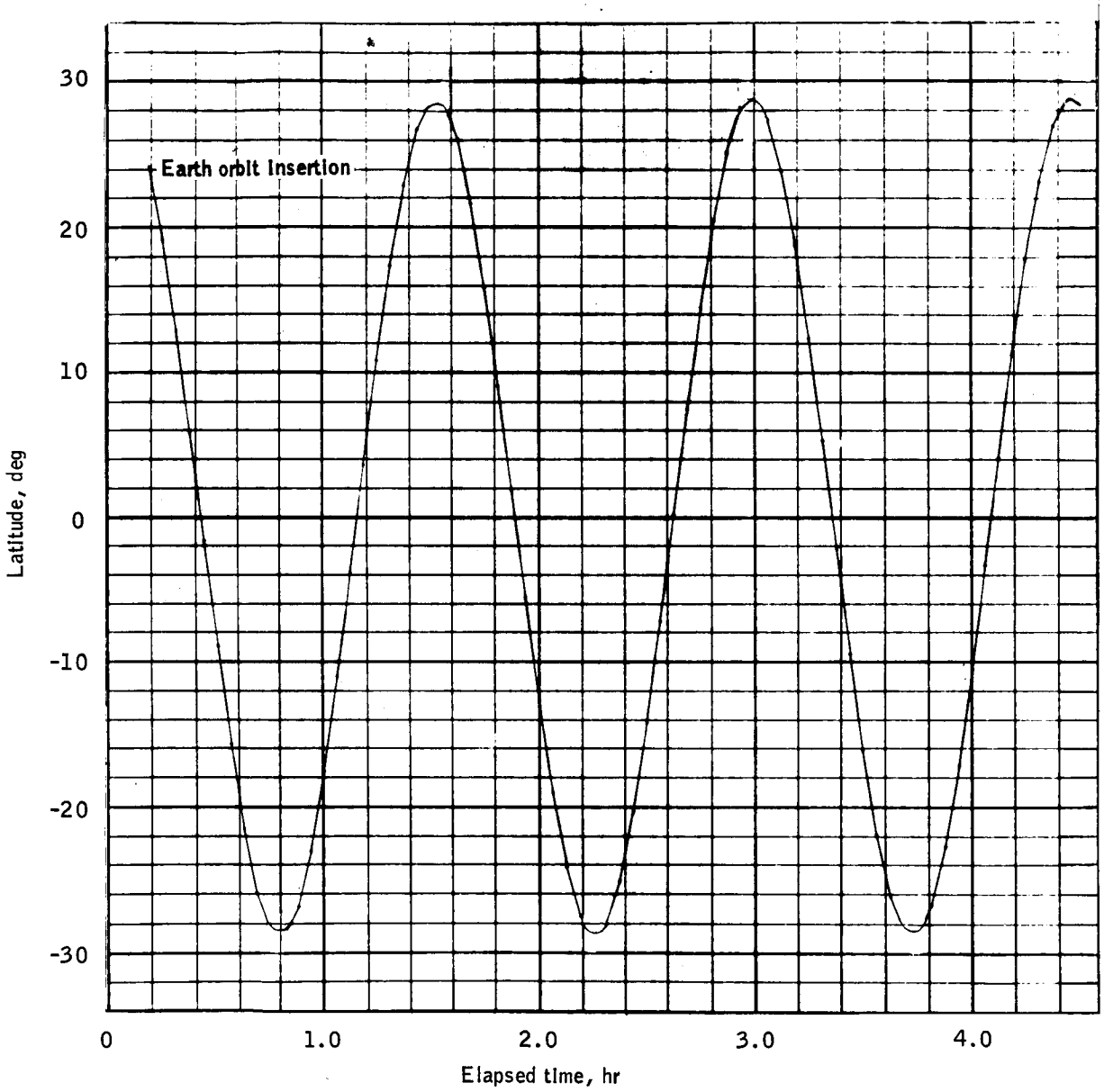
(j) 90 degree launch azimuth.

Figure 2.- Continued.



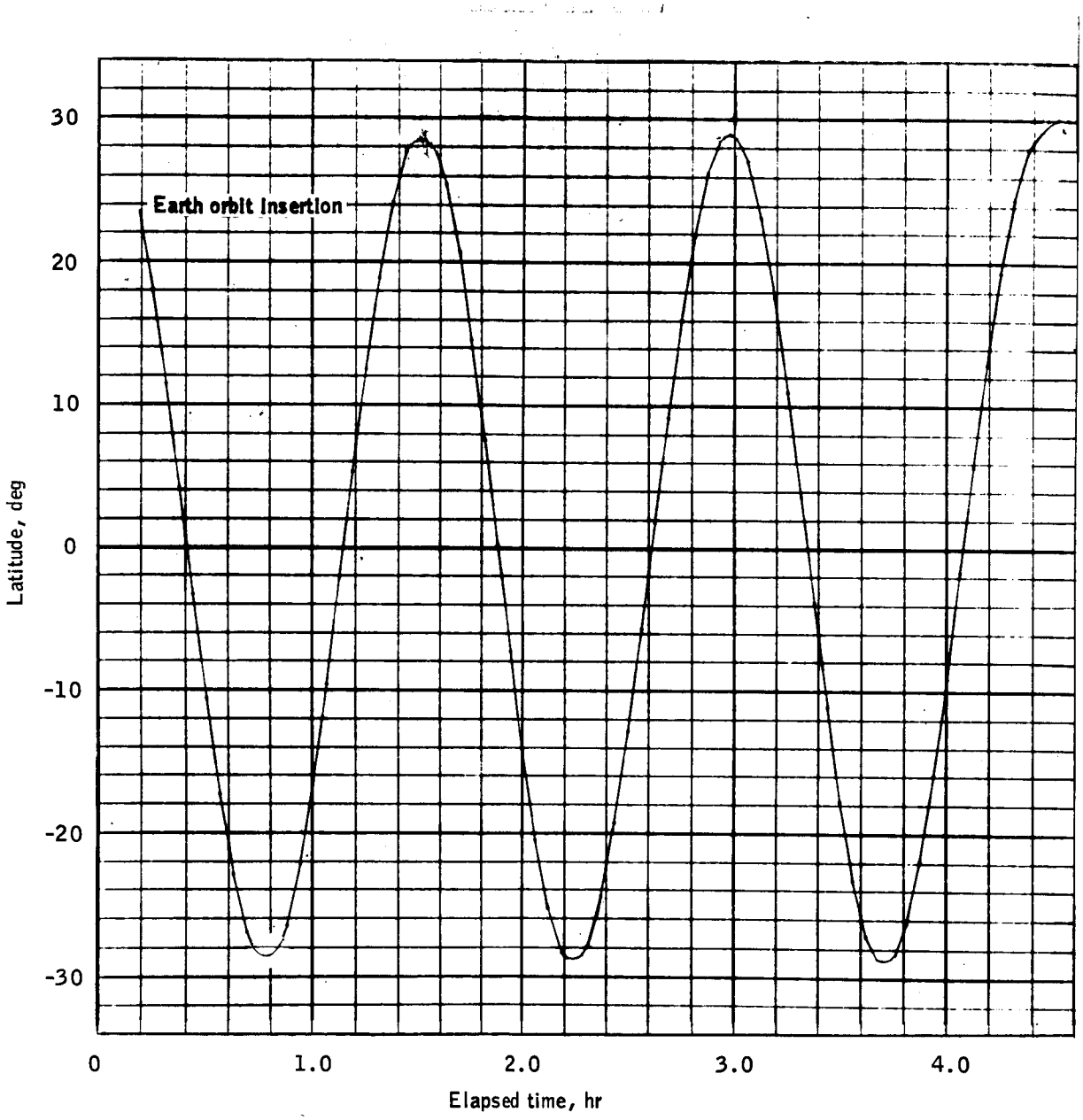
(k) 92 degree launch azimuth.

Figure 2.- Continued.



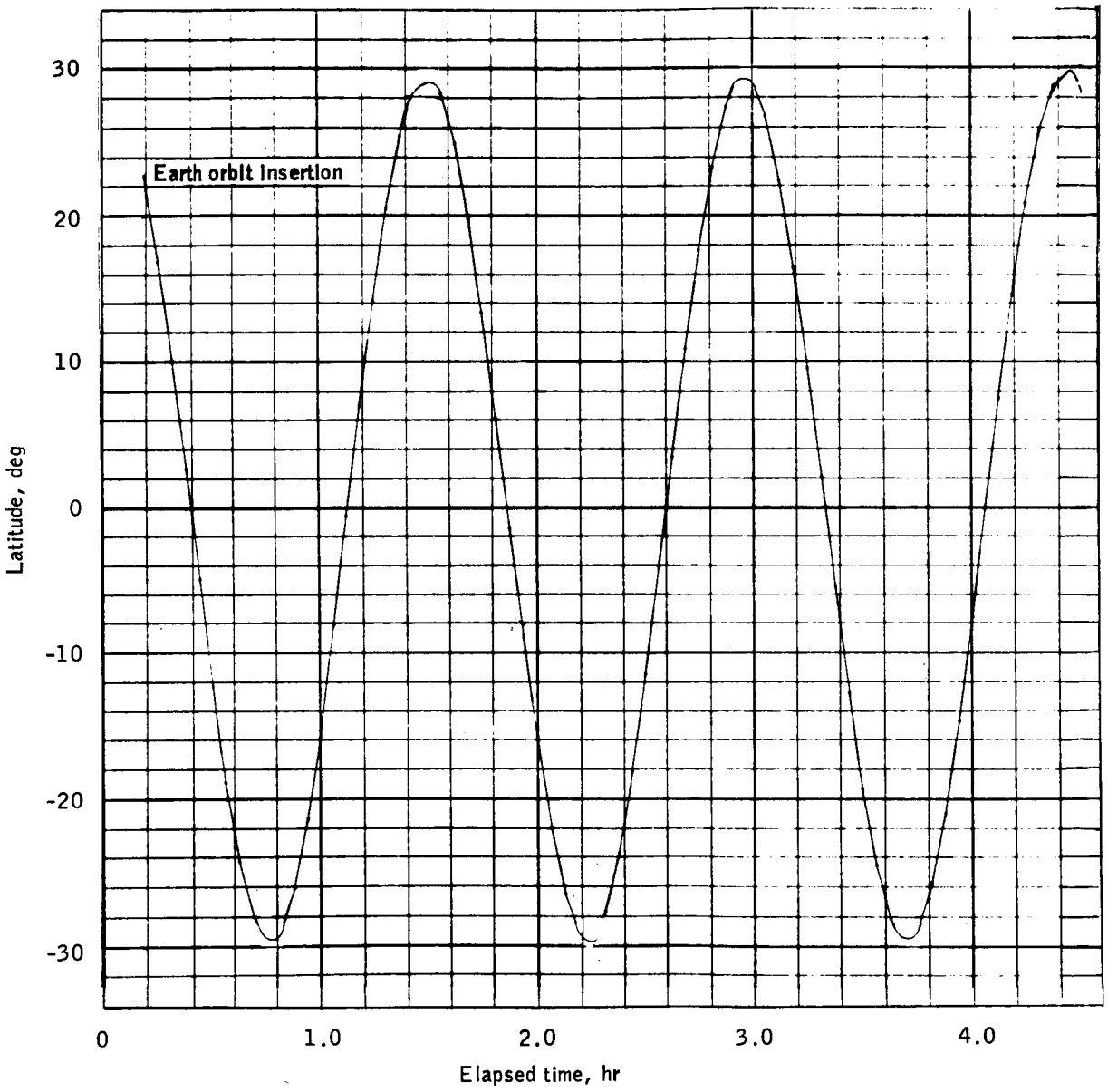
(l) 94 degree launch azimuth.

Figure 2.- Continued.



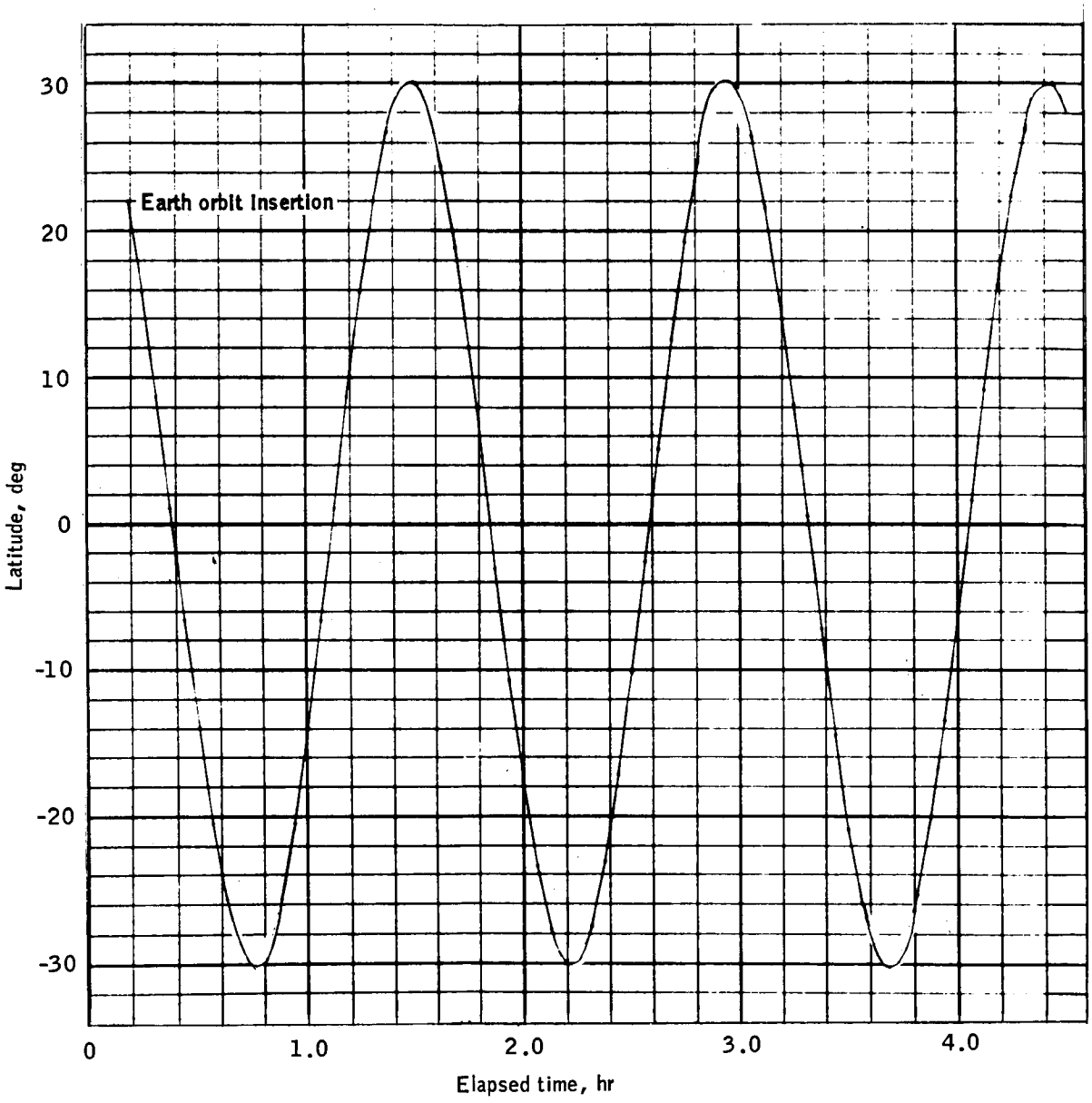
(m) 96 degree launch azimuth.

Figure 2.- Continued.



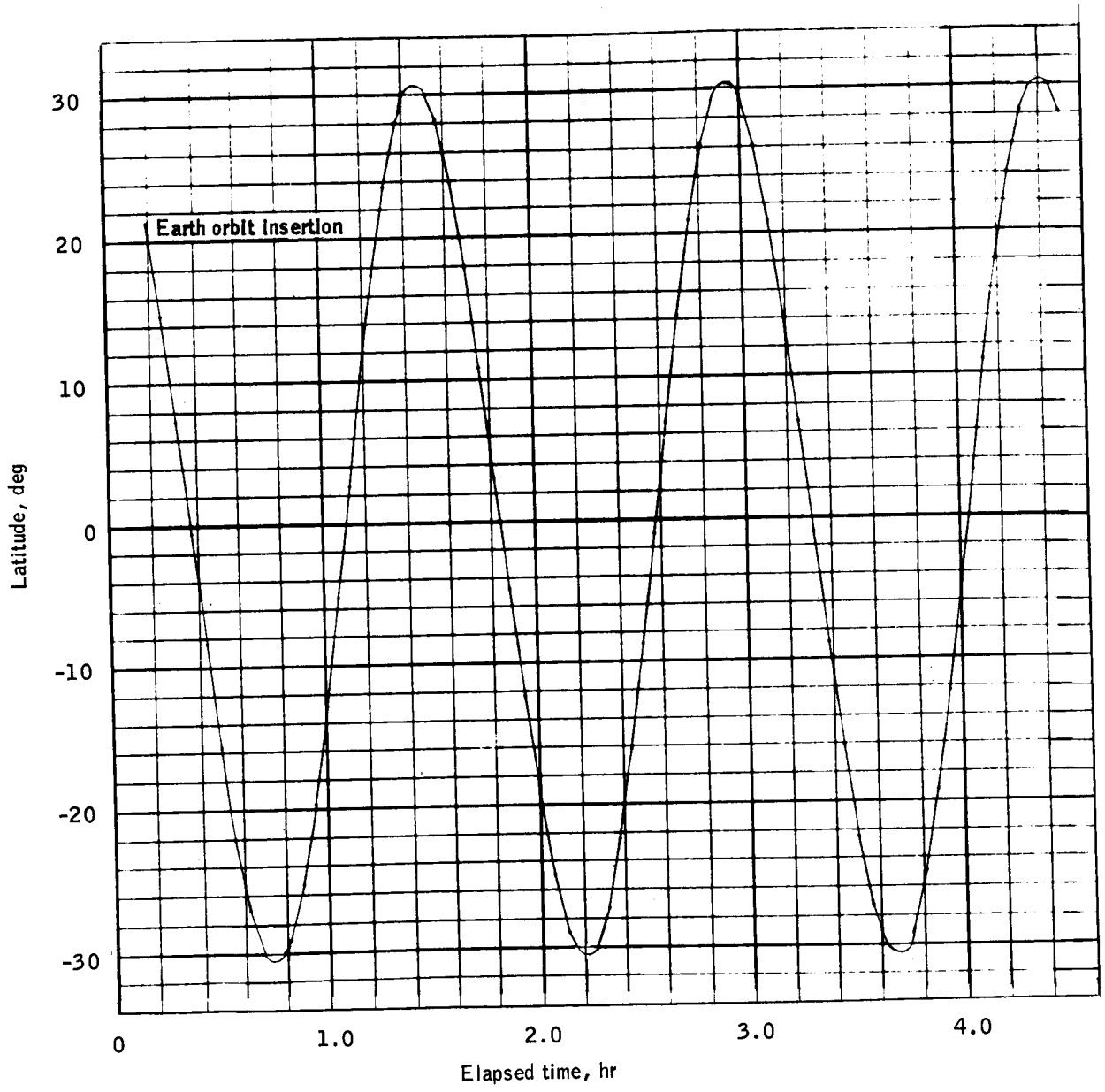
(n) 98 degree launch azimuth.

Figure 2.- Continued.



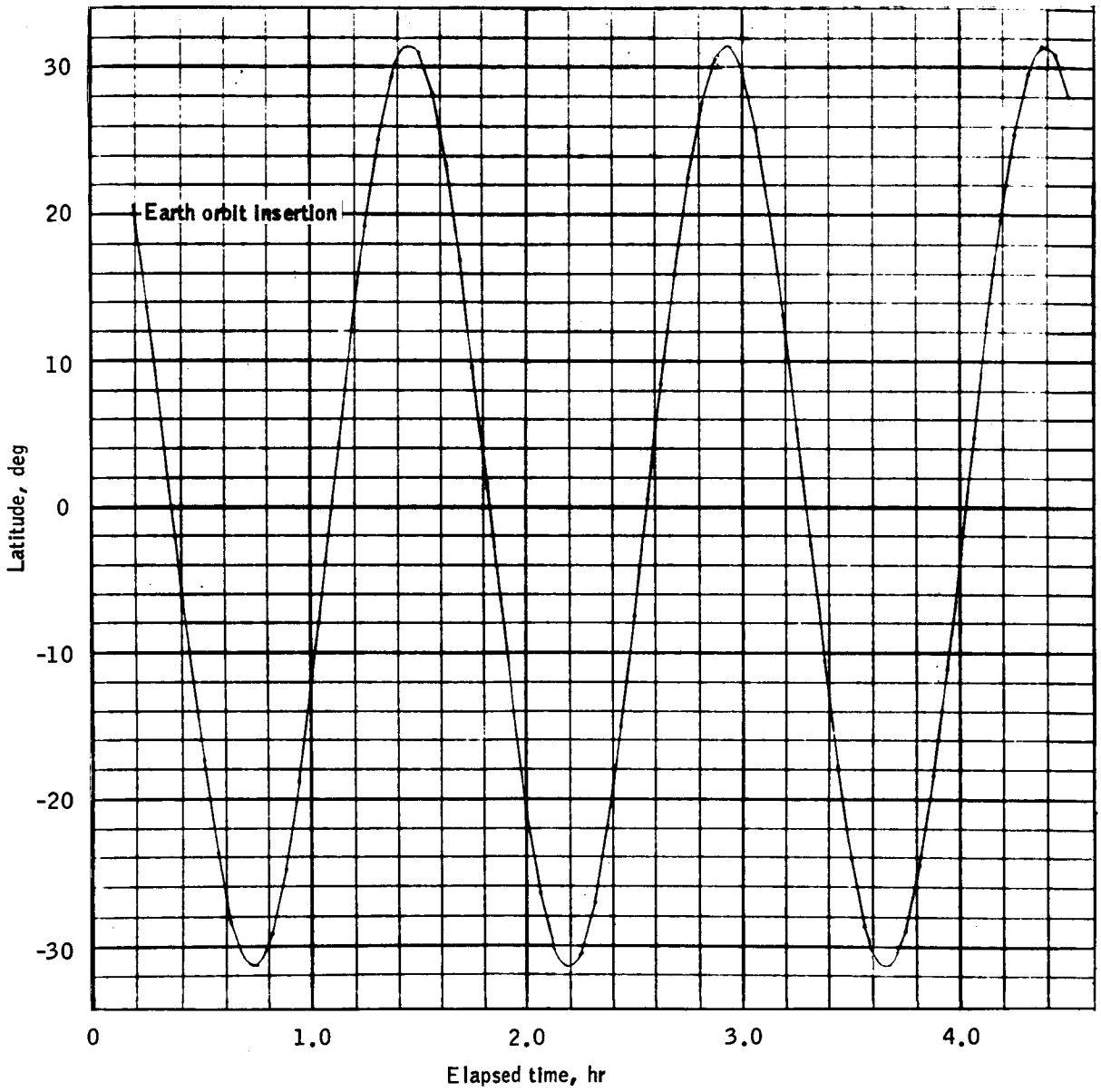
(o) 100 degree launch azimuth.

Figure 2.- Continued.



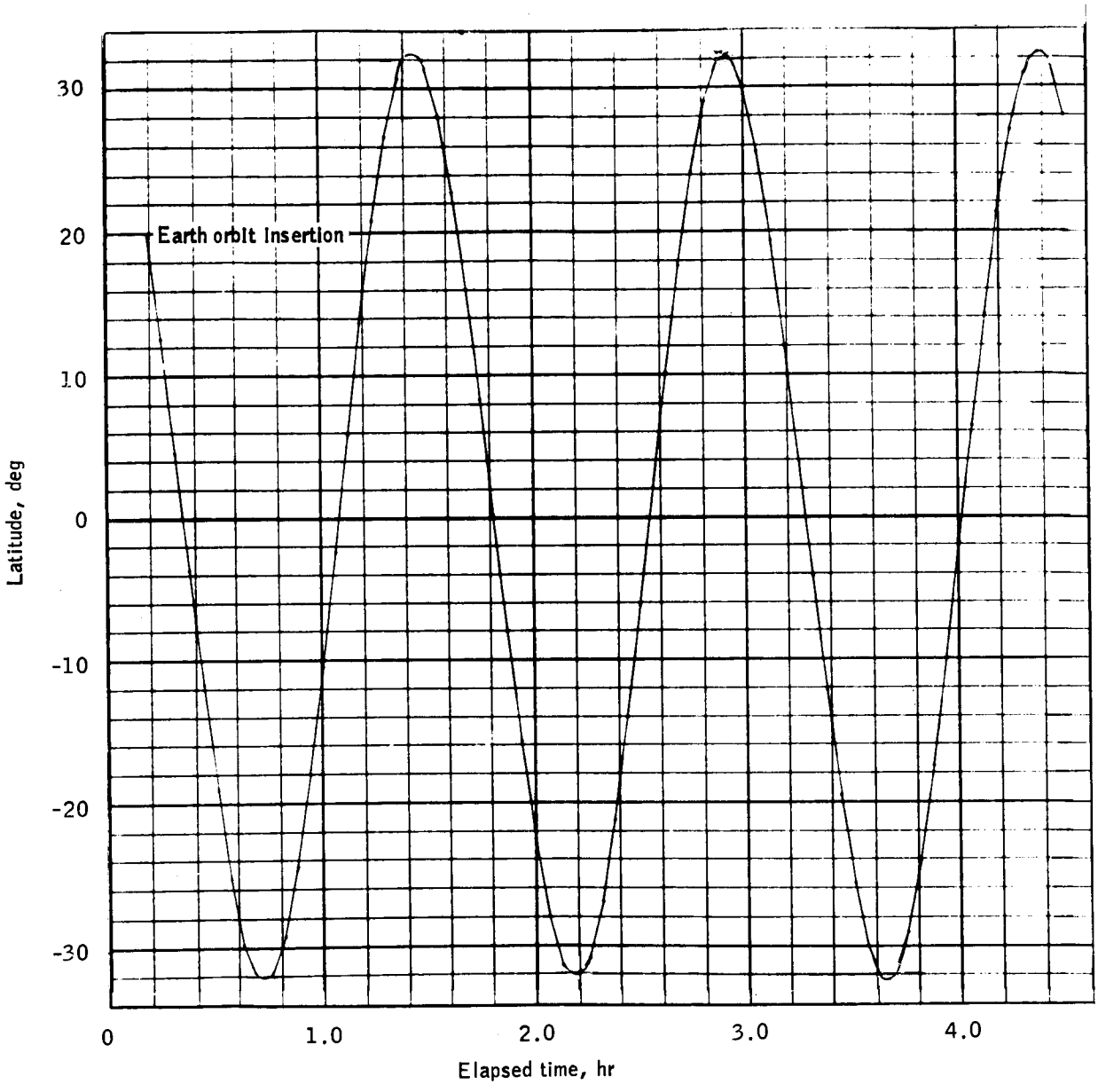
(p) 102 degree launch azimuth.

Figure 2.- Continued.



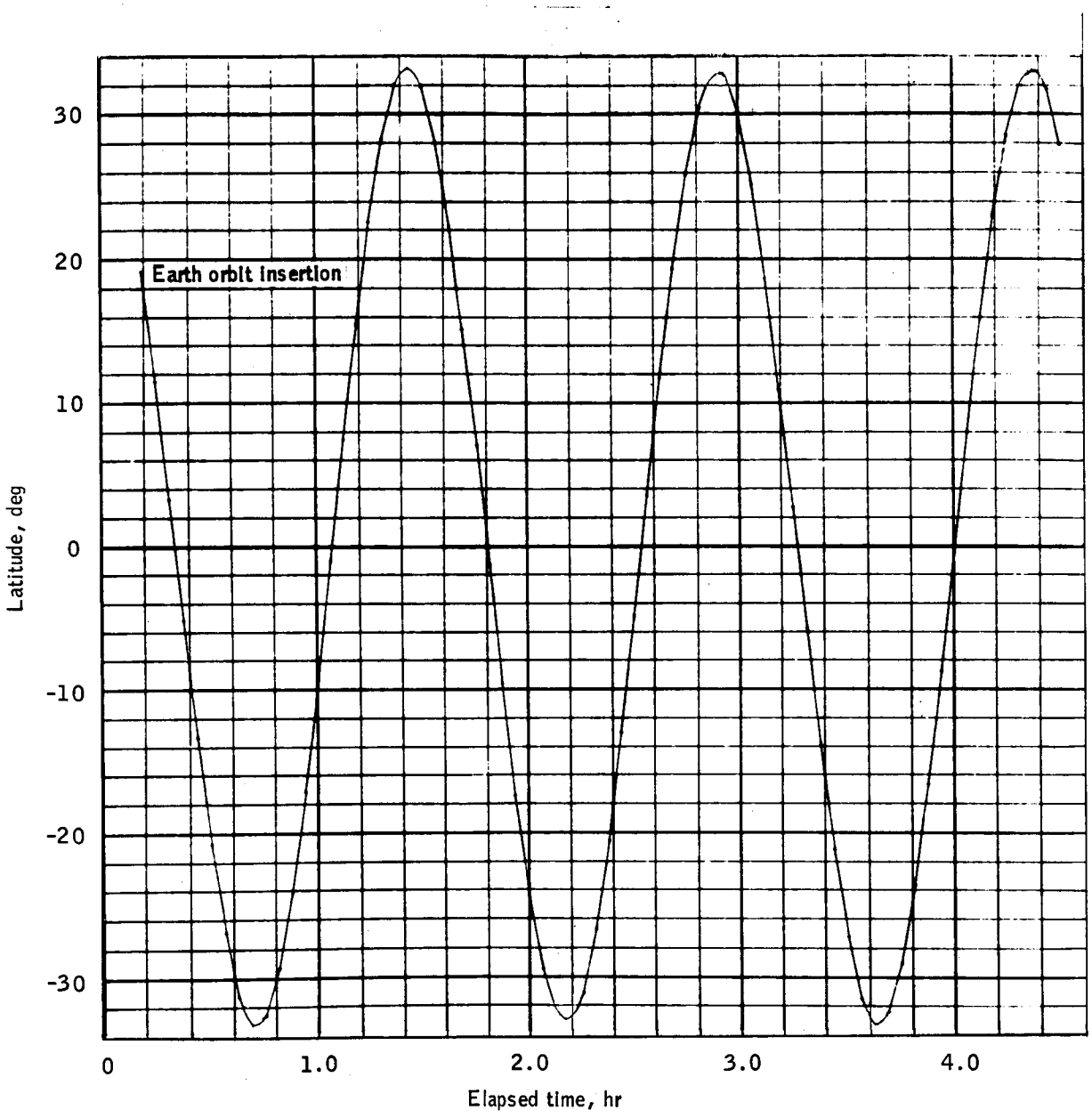
(q) 104 degree launch azimuth.

Figure 2.- Continued.



(r) 106 degree launch azimuth.

Figure 2.- Continued.



(s) 108 degree launch azimuth.

Figure 2.- Concluded.

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1. TRW Systems: Geographic Ground Traces of Apollo Free Return Translunar Injection Burns. Vol. I and Vol. II, NAS 9-4810, Dec. 1, 1966.

2. Chevalier, Luzette M.: Launch Polynomials For EPO Insertion Conditions. NASA 67-FM52-32, February 6, 1967.