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SUMMARY OF NAVY STUDY PERFORMED FOR F4H-1 and F8U-3 WEAPON SYSTEMS

(Parameter Plots for Co-Altitude Attacks)

VOLUME VII

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An investigation is reported of

INTRODUCTION

The Bureau of Aeronautics has contracted with Westinghouse, Air Arm Division, for analytical services to be used in a study to establish the tactical use capability of the F4H-1 and F8U-3 Weapon Systems. This study is conducted under the technical direction of the Naval Research Laboratory with all inputs derived from Navy sources. Westinghouse, using these inputs, will submit analytical results to the Navy. Recommendations and conclusions to be drawn from analytical results are assumed to be a Navy responsibility and in particular the responsibility of the technical directors (NRL). This report is the seventh in a series directed toward carrying out this responsibility.

In Volumes I and III of this series, the effective attack zones for perfectly vectored, co-altitude attacks were presented. Selected samples of plots of parameter variations during the various fire control runs were presented. This volume is a continuation of the parameter plots for these co-altitude attacks. All of the runs presented are for the system employing the current AI radar (AN/APQ-50 or XN-2, AN/APQ-72). These runs originate at the 95% probability of detection point for this radar (12-13 naut mi head-on against B-47 size target). A later volume will present the results for runs made with a system utilizing the improved radar (AN/APQ-72).

The study results, as presented to date, have been separated into study phases (see Volumes I and III). Table I is a summation of these study phases. This same format will be followed in presenting the material of this volume. Table II gives an index of figures contained in this volume. Starting with Fig. III it is seen that the remaining figures are grouped consistent with the format given on Table I. Each of the major categories are indicated by tabs along the edge of the report.

DEFINITION OF PARAMETERS

Since this volume is restricted to those phases of the study which are related to perfectly vectored co-altitude attacks, the parameters which are investigated are those associated with target and interceptor motion during this type of engagement. The parameters, for which graphs showing the variation during the co-altitude attacks are given in this volume, are defined as follows:

R = Range between interceptor and target position

T = Time elapsed from AI radar detection (t_o)

λ_a = Azimuth gimbal angle. This is the angle between the radar gimbal mechanical axis (RGMA) and the line of sight (LOS) in the plane of the azimuth gimbal

λ_e = Elevation gimbal angle. This is the angle between the radar gimbal mechanical axis (RGMA) and the line of sight (LOS) in the plane of the elevation gimbal

$\dot{\lambda}_a$ = Rate of change of azimuth gimbal angle

$\dot{\lambda}_e$ = Rate of change of elevation gimbal angle

λ = Total lead angle (angle between line of sight to target and line of flight of the interceptor)

τ = Target aspect angle (angle between the line of sight to the target and line of flight of the target)

ψ = Angle between the space reference vector and the interceptor velocity vector

ω_j = Angular rate of the line of sight in the elevation plane of the antenna

L/W = Load factor

ϕ = Roll angle

V_F = Fighter velocity

α = Fighter angle of attack. This is the angle between the path frame reference line (FRL) and the fighter flight path

PHASE I-SYSTEM PERFORMANCE UNDER IDEAL CONDITIONS-HORIZONTAL ATTACKS

Following the format used in presenting study results to date, the first case for which parameter plots will be given is that of horizontal attacks under "ideal" conditions.

Figure I gives a pictorial representation of the perfectly vectored co-altitude attack. The target in the illustration is assumed to be nonmaneuvering (cases for maneuvering targets will also be included later in this volume). The interceptor is assumed to start on a perfectly vectored lead pursuit course. On this sketch, λ (total gimbal angle), is the angle between the line of sight (LOS) fighter to target and the line of flight of the fighter. τ_o is the angle between the target heading and the LOS target to fighter. τ_o will be referred to in the remainder of this document as initial target aspect angle (aspect angle at AI radar detection). Figure II shows the courses flown, relative to the target, by the interceptor during a particular situation. Along these courses the interceptor heading is shown by vectors.

The conditions listed on Table I describe the speed and altitude cases of interest. Partial results for these cases are given in Volumes I and II of this series. This phase of this volume is intended as a continuation of these results.

Interceptor at V_{max} at AI Radar Detection

In Volume I the effective attack zones and associated parameter plots for horizontal attacks against a nonmaneuvering target at 30,000 ft and 50,000 ft where $V_T/V_F = 1.0$, 0.8, and 0.45 (V_T = target velocity, V_F = fighter velocity = V_{max}) were given and will not be repeated here. In Volume III the effective attack zones and associated parameter plots for horizontal attacks against a nonmaneuvering target at 1000 ft where $V_T/V_F = 0.8$ ($V_F = V_{max}$) were given and also will not be repeated.

Figures III and IV are copies from Volume III of effective attack zones for the ideal horizontal attack conditions for engagements occurring at 1000 ft altitude for speed ratios of $V_T/V_F = 1.0$ and 0.45. These are repeated here so that the reader can quickly correlate the parameter plots with the corresponding interceptor courses on the polar plots depicting the effective attack zones.

The polar plot of Fig. III shows the effective attack zone for horizontal attacks occurring at 1000 ft altitude under ideal conditions. Detailed description of the polar plots for each condition studied has been given previously in Volumes I and III. However, a general description of this first polar plot (Fig. III) is repeated at this point to assist the reader in utilizing subsequent polar plots and associated parameter variation graphs.

For the situation which resulted in the effective attack zone shown on Fig. III the attack occurred at 1000 ft. The interceptor velocity is 1189 ft/sec and $V_T/V_F = 1.0$. The interceptor was assumed to be on a perfectly vectored lead pursuit course. The target is nonmaneuvering. Curve A gives the 85% probability of detection range for the current radar (AN/APQ-50 or XN-2, AN/APQ-72). Curve B gives the range at AI radar lock on time (estimated as 10 sec after detection throughout the study). The curve labeled C represents the Sparrow III maximum aerodynamic range (interlock equation) and the curve labeled D represents the Sparrow III minimum aerodynamic range (interlock equation). Curve E describes the constant load factor boundary for $N_z = 3$. The 90% cumulative probability of Sparrow III seeker lock-on range is given by Curve F. Sparrow III is currently further limited by a 6.5 naut mi interlock which is shown by Curve G. The effective attack zone is that bounded by the heavy curve. The trajectories for each interceptor course investigated are shown. These courses originated from $\tau = 0^\circ$, 30°, 60°, 70.8°, 90°, 120°, and 150°. The interceptor is restricted to a 3g turn. Referring to the figure, it is seen that the usable approach courses are those between 30° and approximately 70° off the target's nose. The numbers on each of the trajectories represent the time elapsed from t_o (AI radar detection).

Referring to Table II (index of figures) it is seen that the parameter plots have been grouped under the basic polar plot for the target and interceptor conditions of interest. For example, Figs. III-1 thru III-14b give the parameter variations for each of the interceptor trajectories given on the polar plot of Fig. III. (Trajectory for $\tau_o = 0^\circ$ not given.)

With the preceding background information, it is now of interest to investigate the actual parameter plots. A complete description of the first family is in order as an assist to the reader in using the remaining graphs. Throughout this report the first parameter plot of each

family will show the resulting variation in range versus time. This is presented not only to show variation in range, but in order that a ready transformation of the data on the subsequent graphs can be made (some of the parameters are plotted versus time, others versus range). In addition, on the range versus time plot, the following points are labeled:

0 = R_{max}

⊕ = R_{min}

X = Impact for missile launch at R_{min}

□ = L/W = 3

These labeled points can then be transferred readily to the other parameter plots in the associated family.

As far as possible two graphs have been included on one sheet and thus under one figure number. For example, Fig. III-1 consists of two graphs which give the resulting range variation as a function of time for the interceptor trajectories of Fig. III. The top graph gives the range variation for trajectories starting at τ_o = 30°, 60°, 70.8°, 120°, and 150°. The lower graph gives the range variation for the case of τ_o = 90°. Referring to the parameter plots, it is seen that for τ_o = 30°, R_{max} is reached at 5.0 seconds after detection (range = 23,500 ft). R_{min} is reached at 12.2 seconds after detection (range = 8800 ft). The point of impact (arbitrarily chosen for a missile launched at R_{min}) is seen to occur at 15.0 seconds after detection. In following the required lead pursuit course the interceptor encountered L/W = 3 conditions at 13.5 seconds after detection (range = 6000 ft). For the case of τ_o = 60°, R_{max} occurred at 18 seconds after detection. However, R_{min} was never reached, thus this point and the corresponding impact point is not plotted. In following the required lead pursuit course the interceptor never encountered L/W = 3. Referring to the curves for τ_o = 70.8°, 90°, 120°, and 150°, it is seen that none of the points described previously are labeled. For these conditions, R_{max} was never reached. Reference to Fig. III will indicate graphically the same factors brought out above.

Figure III-2 gives curves showing the variation in azimuth gimbal angle (λa) as a function of range. Referring to the course for $\tau_o = 30^o$, it is seen that the azimuth gimbal angle varies from -5° at the range for missile impact to approximately -15°. For the case of $\tau_o = 60^o$ the variation is from -9° to -25° during the run.

The curves of Fig. III-3 give the resulting variation in elevation gimbal angle (λ_e) as a function of range. For the case of $\tau_o = 30^o$, the elevation gimbal angle varies from -4° at the start of the run to -26° at the range for missile impact. It is interesting to note that in flying a lead pursuit trajectory much of the gimbal angle requirement is translated into the elevation axis because of the roll of the interceptor.

Figures III-4a thru III-4c give the rate of change of azimuth gimbal angle ($\dot{\lambda}_a$) as a function of range. For $\tau_o = 30^o$, $\dot{\lambda}_a$ varies from 0 deg/sec to approximately 1.9 deg/sec. Figures III-5a and III-5b give the rate of change of elevation gimbal angle ($\dot{\lambda}_e$) as a function of range. For $\tau_o = 30^o$, $\dot{\lambda}_e$ varies from -0.5 deg/sec to -5 deg/sec.

The curves of Fig. III-6 give the total lead angle (λ) as a function of range. These curves show the combined effects of Figs. III-3 and III-4. Figure III-7 gives the target aspect angle (τ) as a function of range for the corresponding trajectories of Fig. III. The heading angle (Ψ) as a function of range is shown on Fig. III-8.

Figure III-9 gives the azimuth antenna rate (ω_k) versus range. For the case of $\tau_o = 30^o$, ω_k varies from 0.4 deg/sec to 1.2 deg/sec. The elevation antenna rate (ω_j) versus range is shown on Fig. III-10a and Fig. III-10b. Again referring to the curve for $\tau_o = 30^o$, it is seen that ω_j varies from 0 deg/sec at the start of the run to 6 deg/sec at the range for missile impact.

Load factor (L/W) versus range is given by Fig. III-11. The curves of this figure illustrate the "g" build-up as the attack progresses. As was stated previously, one of the barriers in the overlays depicting the effective attack zones is the locus of points described by L/W = 3.

Figure III-12 gives the variation in roll angle (ϕ) versus range. As can be seen from these plots, for the perfect situation (1000 ft altitude attacks), roll angles of 70° and higher can be expected. Figure III-13 gives plots of interceptor velocity (V_F) as a function of time.

These curves illustrate the slowdown of the interceptor while on the approach course. The curves of Fig. III-14a and Fig. III-14b show the angle of attack (α) as a function of time. For the case of $\tau_D = 30$, α at the beginning of the run is approximately 1^o and at 10 seconds after detection starts building up rapidly.

Figure IV gives the co-altitude lead pursuit attack zone overlay for attacks occurring at 1000 ft altitude where the speed ratio (V_T/V_F) is 0.45 and the interceptor starts the engagement at V_{max}. The corresponding parameter plots are given on Figures IV-1 thru IV-14.

Interceptor Under V_{cruise} Conditions at AI Radar Detection-Increased Thrust at Detection

In Volume III, the co-altitude lead prusuit attack zone overlays for conditions where the interceptor starts the attack (AI radar detection) under V_{cruise} conditions and increased thrust is then applied were given. These overlays are repeated here by Figs. V, VI, VII, VIII, and IX. The corresponding parameter plots for the interceptor trajectories are grouped following each of the related attack zone overlays. For example, Fig. V gives the attack zone overlay for attacks occurring at 50,000 ft altitude. The target velocity is 1940 ft/sec. The interceptor starts the attack at V_{cruise} (873 ft/sec). Maximum thrust is applied. The corresponding parameter plots are given by Figs. V-1 thru V-14.

PHASE II-SYSTEM CAPABILITIES FOR SNAP-UP ATTACK UNDER IDEAL CONDITIONS

The results of this phase of study are detailed in Volumes I and III. The related parameter plots are given in Volume VIII.

PHASE III-F4H-1/F8U-3 WEAPON CONTROL SYSTEMS PERFORMANCE UNDER EXPECTED TACTICAL CONDITIONS

In Volume III of this series, the results of the investigation of the effects of target maneuver on the tactical use capability of Sparrow III were detailed. For this phase of the study, the target maneuver was assumed to start at AI radar detection and consisted of a 1g lateral turn which crisscrossed the desired flight. The maximum deviation of target heading from this path is 30^o. The polar plots showing the effective attack zone for the co-altitude, perfectly vectored situation are repeated here as Figs. X and XI. The attack altitude was 30,000 ft and $V_T/V_F = 0.8$ where $V_F = 1897$ ft/sec. Figure X gives the results for a target maneuver initially to the right. Figure XI gives the results for a target maneuver initially to the left. The corresponding parameter variations are given by Figs. X-1a thru X-14c and Figs. XI-1 thru XI-14c.

ACKNOWLEDGEMENTS

The data presented in this report represents a continuation of the results of the Navy's Air-to-Air Missile Study Program. The analytical results, including those from which the figures were derived, are the results of the computation work underway at Westinghouse Air Arm Division. The authors would like to thank the Analytical Section of this division for their major contribution to this report. In addition, the authors would like to thank Laurence F. Gilchrist of the Equipment Research Branch, Naval Research Laboratory for his assistance in the preparation of this report.

TABLE I

OUTLINE OF NAVY AIR-TO-AIR MISSILE SYSTEM STUDY PROGRAM

PHASE I System Performance Under Ideal Conditions

A. Aircraft Characteristics

1. F4H-1
2. F8U-3

B. Altitudes (co-altitude case)

1. 1000 feet or less
2. 30,000 feet
3. 50,000 feet

C. Interceptor Velocity

1. F4H-1 at altitude (V_{max} & V_{cruise})
2. F8U-3 at altitude (V_{max} & V_{cruise})

D. Target to interceptor speed ratio for interceptor at V_{max}

1. 0.45
2. 0.8
3. 1.0

} Some cases may be trivial and will not be used

Target speed resulting from above will be used for interceptor at V_{cruise}

E. Conditions

1. Perfect vectoring
2. Straight line flight path
3. Current AI detection capability
4. B-47 size target
5. Preparation time - two cases determined by study
6. Sparrow III - capability of current seeker is to be used
7. Sparrow III - aerodynamic capability of current missile is to be used
8. Gimbal angle limits in F4H-1 and F8U-3 aircraft
   a. APQ-72
   b. Seeker

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9. Illumination consideration - Geometry of keeping both target and missile illuminated. Illumination requirements to be determined by study.

PHASE II System Snap-up Performance Under Ideal Conditions

A. A, C, D, and E - same as Phase I

B. Altitudes (snap-up case)

1. Target

a. 30,000 feet
b. 50,000 feet
c. 65,000 feet

2. Interceptor Altitude - To be determined by study of system capability.

PHASE III System Performance Under Expected Tactical Conditions

A. Target maneuver

B. Vectoring accuracy

C. Weather

D. Limits imposed by interceptor tactics

1. Climb capability
2. Endurance
3. Dead time

E. Countermeasures

1. Airborne weapons system

PHASE IV System Performance Under Expected Tactical Conditions With Addition of Currently Proposed Improvements

A. Improvements proposed:

1. Search volume optimization

TABLE II

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FIGURE I LEAD PURSUIT PROFILE

FIGURE II LEAD PURSUIT TRAJECTORIES

FIGURE III CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAY
V_T = 1189 ft/sec V_F = 1189 ft/sec Altitude , 1000 ft
(Initial Target Aspect Angle τ_o = 30°, 60°, 70.8°, 90°, 120°, 150°)

Fig. III-1 Range vs Time

Fig. III-2 Azimuth Gimbal Angle vs Range

Fig. III-3 Elevation Gimbal Angle vs Range

Fig. III-4a Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 30°, 60°)

Fig. III-4b Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 70.8°, 90°)

Fig. III-4c Rate of Change of the Azimuth Gimbal Agnle vs Range (τ_o = 120°)

Fig. III-5a Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 30°, 60°, 70.8°)

Fig. III-5b Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 90°, 120°)

Fig. III-6 Tot ⊥ Lead Angle vs Range

Fig. III-7 Target Aspect Angle vs Range

Fig. III-8 Heading Angle vs Range

Fig. III-9 Azimuth Antenna Rate vs Range

Fig. III-10a Elevation Antenna Rate vs Range (τ_o = 30°, 60°)

Fig. III-10b Elevation Antenna Rate vs Range (τ_o = 70.8°,90°,120°,150°)

Fig. III-11 Load Factor vs Range

Fig. III-12 Roll Angle vs Range

Fig. III-13 Fighter Speed vs Time

Fig. III-14a Angle of Attack vs Time (τ_o = 30°,60°,70.8°,120°,150°)

Fig. III-14b Angle of Attack vs Time (τ_o = 90°)

FIGURE IV CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAY
V_T = 533 ft/sec V_F = 1189 ft/sec Altitude = 1000 ft
(Initial Target Aspect Angle τ_o = 30°, 60°, 90°, 120°, 150°)

Fig. IV-1 Range vs Time

Fig. IV-2 Azimuth Gimbal Angle vs Range

Fig. IV-3 Elevation Gimbal Angle vs Range

Fig. IV-4a Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 30°, 60°)

Fig. IV-4b Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 90°, 120°)

Fig. IV-4c Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 150°)

Fig. IV-5a Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 30°, 60°, 90°)

Fig. IV-5b Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 120°, 150°)

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Fig. IV-9a Azimuth Antenna Rate vs Range (τ_0 = 30°, 60°, 90°)

Fig. IV-9b Azimuth Antenna Rate vs Range (τ_0 = 120°, 150°)

Fig. IV-10a Elevation Antenna Rate vs Range (τ_0 = 30°, 60°)

Fig. IV-10b Elevation Antenna Rate vs Range (τ_0 = 90°, 120°)

Fig. IV-10c Elevation Antenna Rate vs Range (τ_0 = 150°)

Fig. IV-11a Load Factor vs Range (τ_0 = 30°, 60°)

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Fig. IV-11c Load Factor vs Range (τ_0 = 150°)

Fig. IV-12 Roll Angle vs Range

Fig. IV-13 Fighter Speed vs Time

Fig. IV-14 Angle of Attack vs Time

FIGURE V CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAY
V_T = 1940 ft/sec V_F = 873 (V_{cruise}-Increased Thrust at Detection) Altitude = 50,000 ft
(Initial Target Aspect Angle τ_0 = 30°, 60°)

Fig. V-1 Range vs Time

ig. V-2 Azimuth Gimbal Angle vs Range

Fig. V-3 Elevation Gimbal Angle vs Range

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Fig V-5 Rate of Change of the Elevation Gimbal Angle vs Range

Fi- V-6 Total Lead Angle vs Range

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Fig. V-8 Heading Angle vs Range

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Fig. V-10 Elevation Antenna Rate vs Range

Fig. V-11 Load Factor vs Range

Fig. V-12 Roll Angle vs Range

Fig. V-13 Fighter Speed vs Time

Fig. V-14 Angle of Attack vs Time

FIGURE VI CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAY
V_T = 1552 ft/sec V_F = 873 ft/sec (V_{cruise}-Increased Thrust at Detection) Altitude = 50,000 ft)
(Initial Target Aspect Angle τ_o = 30°, 60°, 90°)

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Fig. VI-1b Range vs Time (τ_o = 90°)

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Fig. VI-3 Elevation Gimbal Angle vs Range

Fig. VI-4a Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 30°, 60°)

Fig. VI-4b Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 90°)

Fig. VI-5a Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 30°, 60°)

Fig. VI-5b Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 90°)

Fig. VI-6 Total Lead Angle vs Range

Fig. VI-7 Target Aspect Angle vs Range

Fig. VI-8 Heading Angle vs Range

Fig. VI-9 Azimuth Antenna Rate vs Range

Fig. VI-10 Elevation Antenna Rate vs Range

Fig. VI-11 Load Factor vs Range

Fig. VI-12 Roll Angle vs Range

Fig. VI-13a Fighter Speed vs Time (τ_0 = 30°, 60°)

Fig. VI-13b Fighter Speed vs Time (τ_0 = 90°)

Fig. VI-14 Angle of Attack vs Time

FIGURE VII CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAY
V_T = 873 ft/sec V_F = 873 ft/sec (V_{cruise}-Increased Thrust at Detection) Altitude = 50,000 ft
(Initial Target Aspect Angle τ_0 = 30°, 60°, 90°, 120°, 150°)

Fig. VII-1 Range vs Time

Fig. VII-2a Azimuth Gimbal Angle vs Range (τ_0 = 30°, 60°, 90°)

Fig. VII-2b Azimuth Gimbal Angle vs Range (τ_0 = 120°, 150°)

Fig. VII-3 Elevation Gimbal Angle vs Range

Fig. VII-4a Rate of Change of the Azimuth Gimbal Angle vs Range (τ_0 = 30°, 60°)

Fig. VII-4b Rate of Change of the Azimuth Gimbal Angle vs Range (τ_0 = 90°, 120°)

Fig. VII-4c Rate of Change of the Azimuth Gimbal Angle vs Range (τ_0 = 150°)

Fig. VII-5a Rate of Change of the Elevation Gimbal Angle vs Range ($\tau_0 = 30^\circ, 60^\circ$)

Fig. VII-5b Rate of Change of the Elevation Gimbal Angle vs Range ($\tau_0 = 90^\circ, 120^\circ, 150^\circ$)

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Fig. VII-7 Target Aspect Angle vs Range

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Fig. VII-9b Azimuth Antenna Rate vs Range ($\tau_0 = 90^\circ, 120^\circ, 150^\circ$)

Fig. VII-10a Elevation Antenna Rate vs Range ($\tau_0 = 30^\circ, 60^\circ$)

Fig. VII-10b Elevation Antenna Rate vs Range ($\tau_0 = 90^\circ, 120^\circ$)

Fig. VII-10c Elevation Antenna Rate vs Range ($\tau_0 = 150^\circ$)

Fig. VII-11a Load Factor vs Range ($\tau_0 = 30^\circ, 60^\circ, 90^\circ, 120^\circ$)

Fig. VII-11b Load Factor vs Range ($\tau_0 = 150^\circ$)

Fig. VII-12 Roll Angle vs Range

Fig. VII-13a Fighter Speed vs Time ($\tau_0 = 30^\circ, 60^\circ, 90^\circ$)

Fig. VII-13b Fighter Speed vs Time ($\tau_0 = 120^\circ, 150^\circ$)

Fig. VII-14a Angle of Attack vs Time ($\tau_0 = 30^\circ, 60^\circ, 90^\circ$)

Fig. VII-14b Angle of Attack vs Time ($\tau_0 = 120^\circ, 150^\circ$)

FIGURE VIII CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAY
V_T = 1897 ft/sec V_P = 894 ft/sec (V_{cruise}-Increased Thrust at Detection) Altitude = 30,000 ft
(Initial Target Aspect Angle τ_o = 30°)

Fig. VIII-1 Range vs Time

Fig. VIII-2 Azimuth Gimbal Angle vs Range

Fig. VIII-3 Elevation Gimbal Angle vs Range

Fig. VIII-4 Rate of Change of the Azimuth Gimbal Angle vs Range

Fig. VIII-5 Rate of Change of the Elevation Gimbal Angle vs Range

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Fig. VIII-10 Elevation Antenna Rate vs Range

Fig. VIII-11 Load Factor vs Range

Fig. VIII-12 Roll Angle vs Range

Fig. VIII-13 Fighter Speed vs Time

Fig. VIII-14 Angle of Attack vs Time

FIGURE IX CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAY
V_T = 1518 ft/sec V_P = 894 ft/sec (V_{cruise}-Increased Thrust at Detection) Altitude = 30,000 ft
(Initial Target Aspect Angle τ_o = 30°, 60°, 90°)

Fig. IX-1a Range vs Time (τ_o = 30°, 60°)

Fig. IX-1b Range vs Time (τ_o = 90°)

Fig. IX-2 Azimuth Gimbal Angle vs Range

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Fig. IX-7 Target Aspect Angle vs Range

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Fig. IX-9 Azimuth Antenna Rate vs Range

Fig. IX-10a Elevation Antenna Rate vs Range ($\tau_0 = 30^\circ, 60^\circ$)

Fig. IX-10b Elevation Antenna Rate vs Range ($\tau_0 = 90^\circ$)

Fig. IX-11a Load Factor vs Range ($\tau_0 = 30^\circ, 60^\circ$)

Fig. IX-11b Load Factor vs Range ($\tau_0 = 90^\circ$)

Fig. IX-12 Roll Angle vs Range

Fig. IX-13 Fighter Speed vs Time

Fig. IX-14a Angle of Attack vs Time ($\tau_0 = 30^\circ, 60^\circ$)

Fig. IX-14b Angle of Attack vs Time ($\tau_0 = 90^\circ$)

FIGURE X CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS
V_T = 1518 ft/sec V_P = 1097 ft/sec Altitude = 30,000 ft
Maneuvering Target - Initial Right Turn
(Initial Target Aspect Angle τ_o = 30°, 60°, 90°, 120°, 150°)

Fig. X-1a	Range vs Time (τ_o = 30°, 60°)
Fig. X-1b	Range vs Time (τ_o = 90°, 120°)
Fig. X-1c	Range vs Time (τ_o = 150°)
Fig. X-2a	Azimuth Gimbal Angle vs Range (τ_o = 30°, 60°)
Fig. X-2b	Azimuth Gimbal Angle vs Range (τ_o = 90°, 120°)
Fig. X-2c	Azimuth Gimbal Angle vs Range (τ_o = 150°)
Fig. X-3a	Elevation Gimbal Angle vs Range (τ_o = 30°, 60°)
Fig. X-3b	Elevation Gimbal Angle vs Range (τ_o = 90°, 120°)
Fig. X-3c	Elevation Gimbal Angle vs Range (τ_o = 150°)
Fig. X-4a	Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 30°, 60°)
Fig. X-4b	Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 90°, 120°)
Fig. X-4c	Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 150°)
Fig. X-5a	Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 30°, 60°)
Fig. X-5b	Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 90°, 120°)
Fig. X-5c	Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 150°)

Fig. X-6a Total Lead Angle vs Range (τ_o = 30°, 60°)

Fig. X-6b Total Lead Angle vs Range (τ_o = 90°, 120°)

Fig. X-6c Total Lead Angle vs Range (τ_o = 150°)

Fig. X-7a Target Aspect Angle vs Range (τ_o = 30°, 60°)

Fig. X-7b Target Aspect Angle vs Range (τ_o = 90°, 120°)

Fig. X-7c Target Aspect Angle vs Range (τ_o = 150°)

Fig. X-8a Heading Angle vs Range (τ_o = 30°, 60°)

Fig. X-8b Heading Angle vs Range (τ_o = 90°, 120°)

Fig. X-8c Heading Angle vs Range (τ_o = 150°)

Fig. X-9a Azimuth Antenna Rate vs Range (τ_o = 30°, 60°)

Fig. X-9b Azimuth Antenna Rate vs Range (τ_o = 90°, 120°)

Fig. X-9c Azimuth Antenna Rate vs Range (τ_o = 150°)

Fig. X-10a Elevation Antenna Rate vs Range (τ_o = 30°, 60°)

Fig. X-10b Elevation Antenna Rate vs Range (τ_o = 90°, 120°)

Fig. X-10c Elevation Antenna Rate vs Range (= 150°)

Fig. X-11a Load Factor vs Range (τ_o = 30°, 60°)

Fig. X-11b Load Factor vs Range (τ_o = 90°, 120°)

Fig. X-11c Load Factor vs Range (τ_o = 150°)

Fig. X-12a Roll Angle vs Range (τ_o = 30°, 60°)

Fig. X-12b Roll Angle vs Range (τ_o = 90°, 120°)

Fig. X-12c Roll Angle vs Range (τ_o = 150°)

Fig. X-13a Fighter Speed vs Time (τ_o = 30°, 60°, 90°)

Fig. X-13b Fighter Speed vs Time (τ_o = 120°, 150°)

Fig. X-14a Angle of Attack vs Time (τ_o = 30°, 60°)

Fig. X-14b Angle of Attack vs Time (τ_o = 90°, 120°)

Fig. X-14c Angle of Attack vs Time (τ_o = 150°)

FIGURE XI CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS
V_T = 1518 ft/sec V_F = 1897 ft/sec Altitude = 30,000 ft
Maneuvering Target - Initial Left Turn
(Initial Target Aspect Angle τ_o = 0°,30°,60°,90°,120°,150°)

Fig. XI-1 Range vs Time

Fig. XI-2a Azimuth Gimbal Angle vs Range (τ_o = 0°, 30°)

Fig. XI-2b Azimuth Gimbal Angle vs Range (τ_o = 60°, 90°)

Fig. XI-2c Azimuth Gimbal Angle vs Range (τ_o = 120°, 150°)

Fig. XI-3a Elevation Gimbal Angle vs Range (τ_o = 0°, 30°, 60°)

Fig. XI-3b Elevation Gimbal Angle vs Range (τ_o = 90°, 120°)

Fig. XI-3c Elevation Gimbal Angle vs Range (τ_o = 150°)

Fig. XI-4a Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 0°, 30°)

Fig. XI-4b Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 60°, 90°)

Fig. XI-4c Rate of Change of the Azimuth Gimbal Angle vs Range (τ_o = 120°, 150°)

Fig. XI-5a Rate of Change of the Elevation Gimbal Angle vs Range (τ_o = 0°, 30°, 60°)

Fig. XI-5b Rate of Change of the Elevation Gimbal Angle vs Range ($\tau_o = 90^o, 120^o$)

Fig. XI-5c Rate of Change of the Elevation Gimbal Angle vs Range ($\tau_o = 150^o$)

Fig. XI-6a Total Lead Angle vs Range ($\tau_o = 0^o, 30^o$)

Fig. XI-6b Total Lead Angle vs Range ($\tau_o = 60^o, 90^o$)

Fig. XI-6c Total Lead Angle vs Range ($\tau_o = 120^o, 150^o$)

Fig. XI-7a Target Aspect Angle vs Range ($\tau_o = 0^o, 30^o$)

Fig. XI-7b Target Aspect Angle vs Range ($\tau_o = 60^o, 90^o$)

Fig. XI-7c Target Aspect Angle vs Range ($\tau_o = 120^o, 150^o$)

Fig. XI-8a Heading Angle vs Range ($\tau_o = 0^o, 30^o$)

Fig. XI-8b Heading Angle vs Range ($\tau_o = 60^o, 90^o$)

Fig. XI-8c Heading Angle vs Range ($\tau_o = 120^o, 150^o$)

Fig. XI-9a Azimuth Antenna Rate vs Range ($\tau_o = 0^o, 30^o$)

Fig. XI-9b Azimuth Antenna Rate vs Range ($\tau_o = 60^o, 90^o$)

Fig. XI-9c Azimuth Antenna Rate vs Range ($\tau_o = 120^o, 150^o$)

Fig. XI-10a Elevation Antenna Rate vs Range ($\tau_o = 0^o, 30^o$)

Fig. XI-10b Elevation Antenna Rate vs Range ($\tau_o = 60^o, 90^o$)

Fig. XI-10c Elevation Antenna Rate vs Range ($\tau_o = 120^o, 150^o$)

Fig. XI-11a Load Factor vs Range ($\tau_o = 0^o, 30^o$)

Fig. XI-11b Load Factor vs Range ($\tau_o = 60^o, 90^o$)

Fig. XI-11c Load Factor vs Range (τ_o = 120°, 150°)

Fig. XI-12a Roll Angle vs Range (τ_o = 0°, 30°)

Fig. XI-12b Roll Angle vs Range (τ_o = 60°, 90°)

Fig. XI-12c Roll Angle vs Range (τ_o = 120°, 150°)

Fig. XI-13a Fighter Speed vs Time (τ_o = 0°, 30°, 60°)

Fig. XI-13b Fighter Speed vs Time (τ_o = 90°, 120°)

Fig. XI-13c Fighter Speed vs Time (τ_o = 150°)

Fig. XI-14a Angle of Attack vs Time (τ_o = 0°, 30°, 60°)

Fig. XI-14b Angle of Attack vs Time (τ_o = 90°, 120°)

Fig. XI-14c Angle of Attack vs Time (τ_o = 150°)

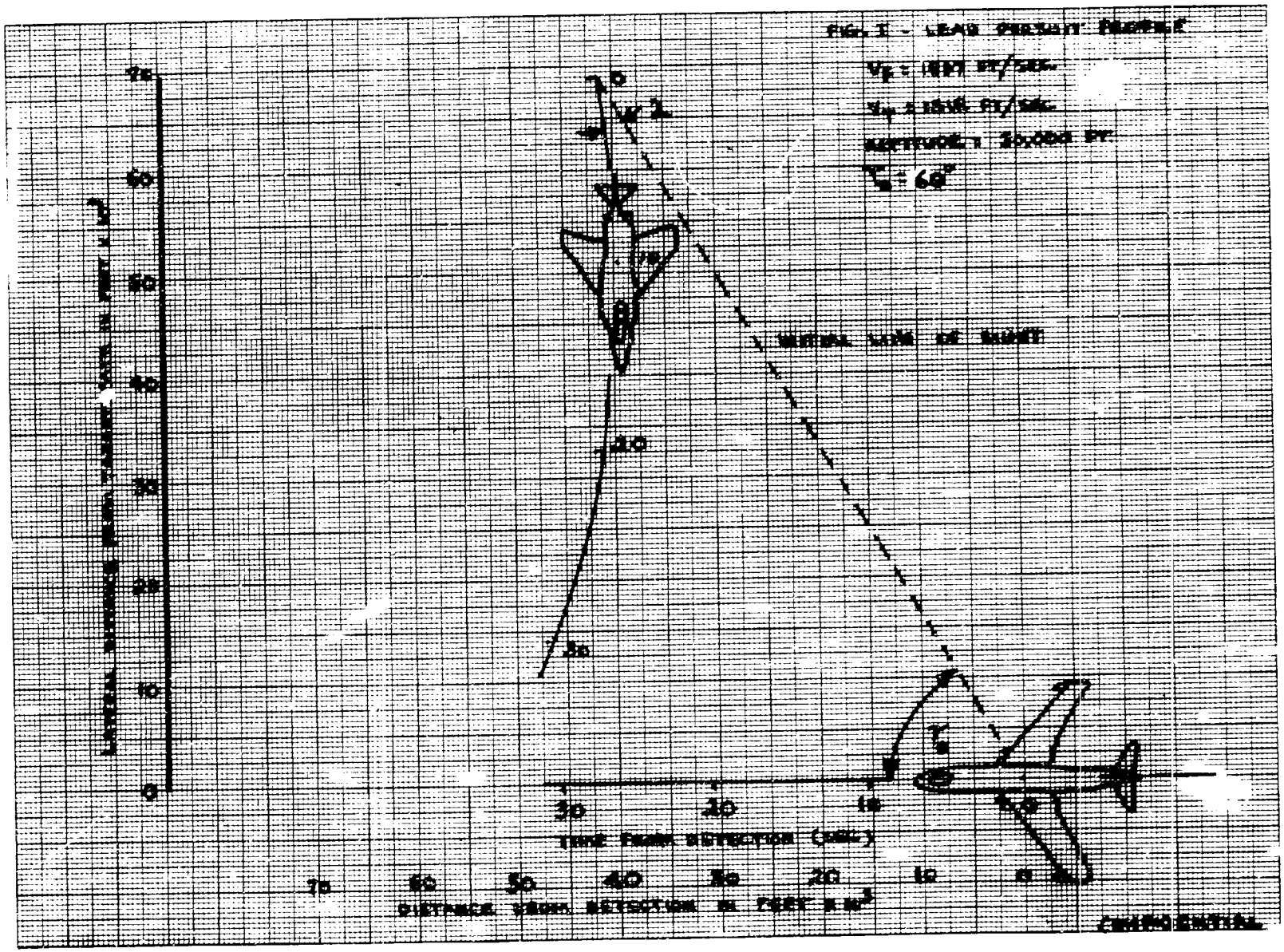
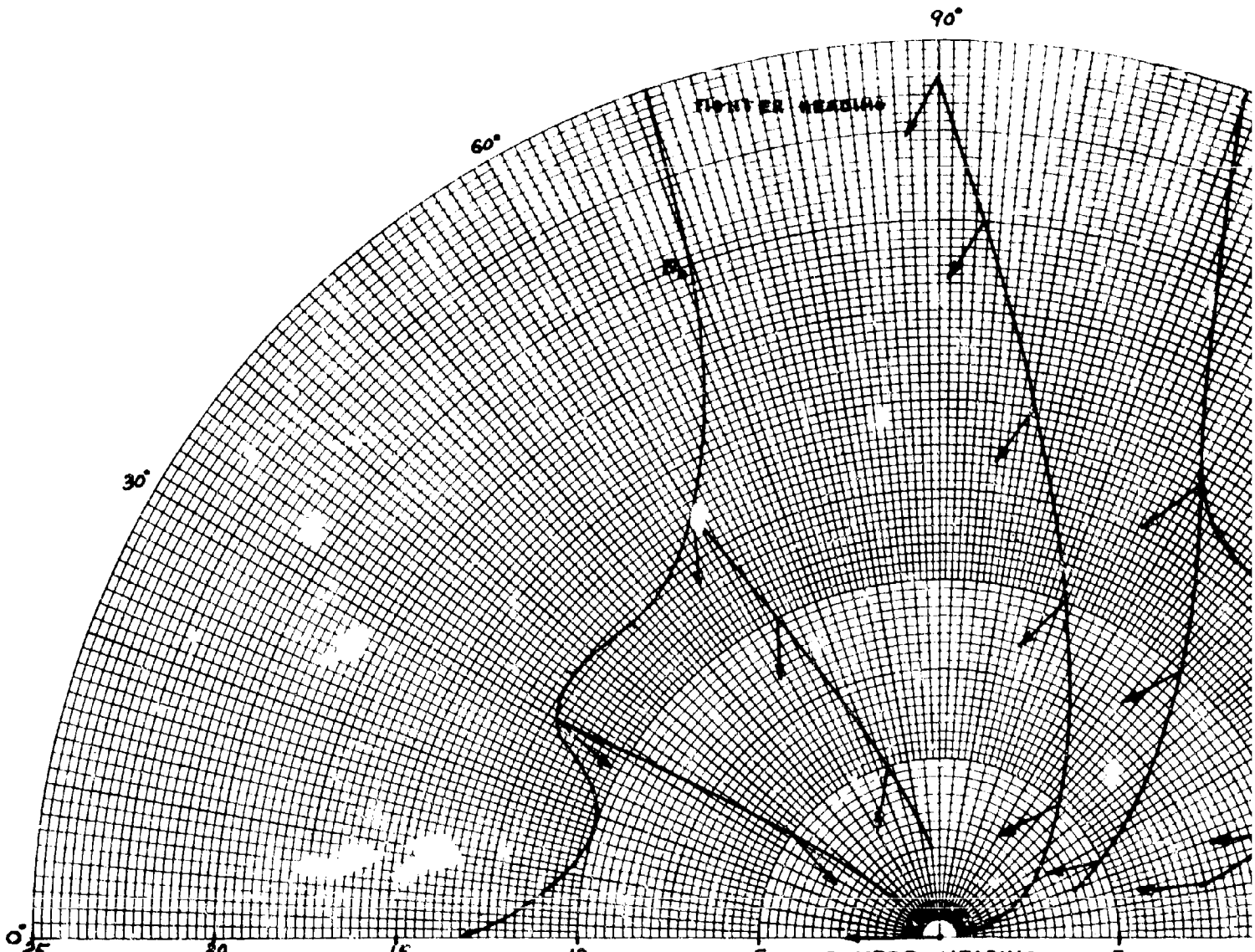
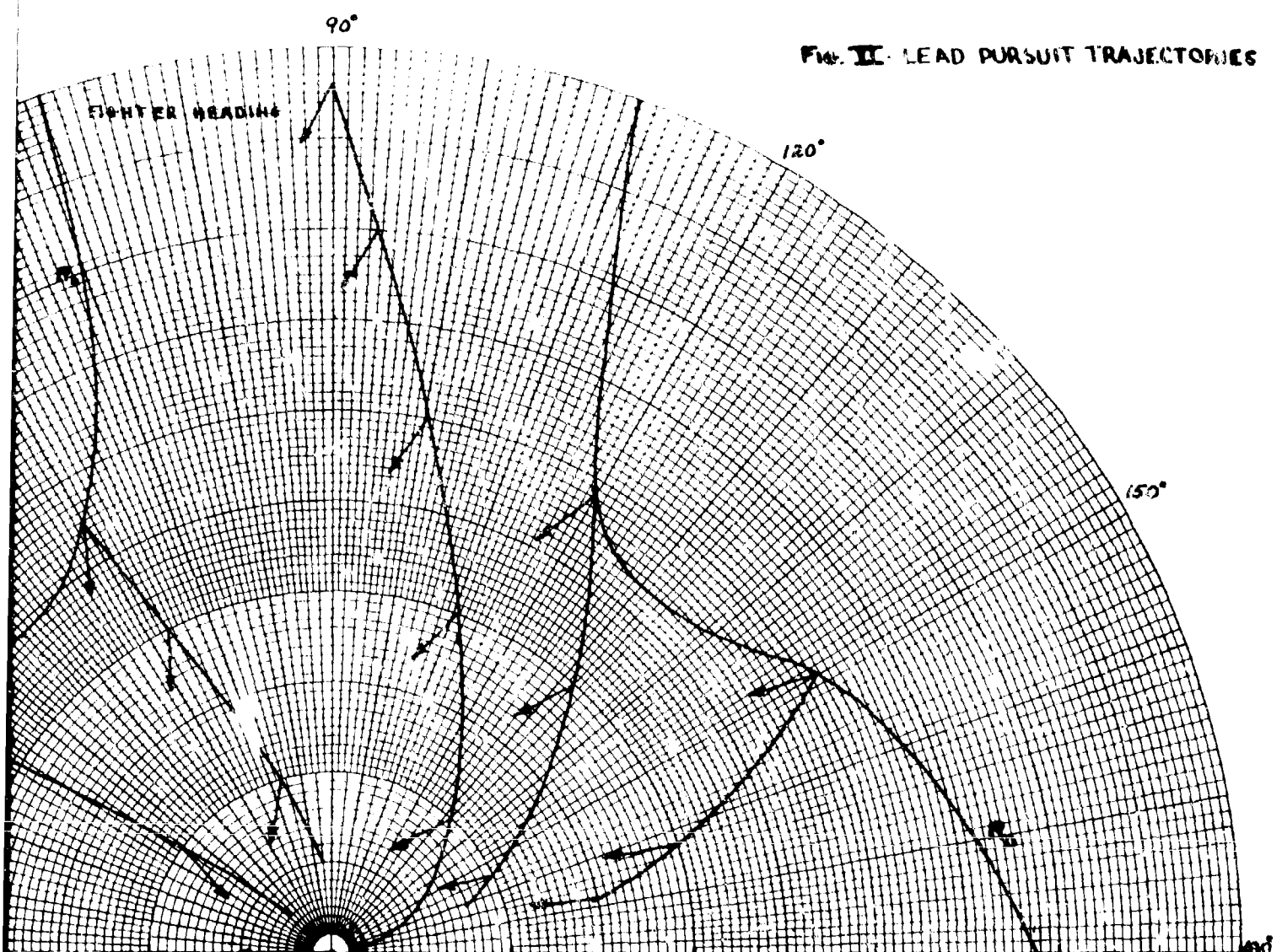


FIG. I - LEAD PURSUIT PROBLEM
V_T = 1000 FT/SEC.
V_M = 1500 FT/SEC.
ALTITUDE = 20,000 FT.
Γ_0 = 60°
INITIAL LINE OF SIGHT
TIME FROM DETECTION (SEC.)
DISTANCE FROM DETECTION IN FEET X 10^3
CURVE SMITH

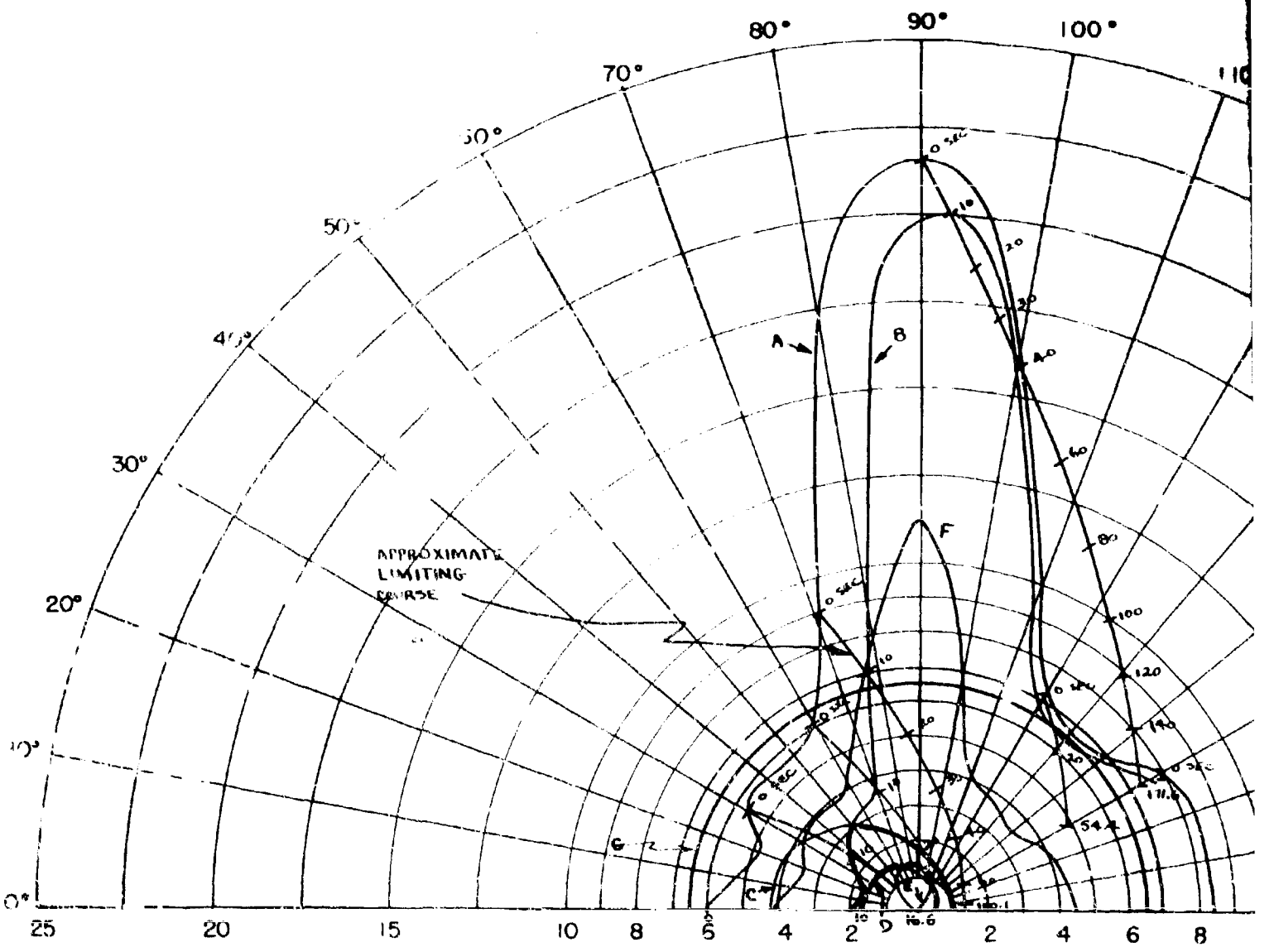


V_F = 1897 Ft. Per Sec.
V_T = 1518 Ft. Per Sec.
ALTITUDE = 30,000 Ft.
⟶ = FIGHTER HEADING

FIG. II - LEAD PURSUIT TRAJECTORIES



CONFIDENTIAL

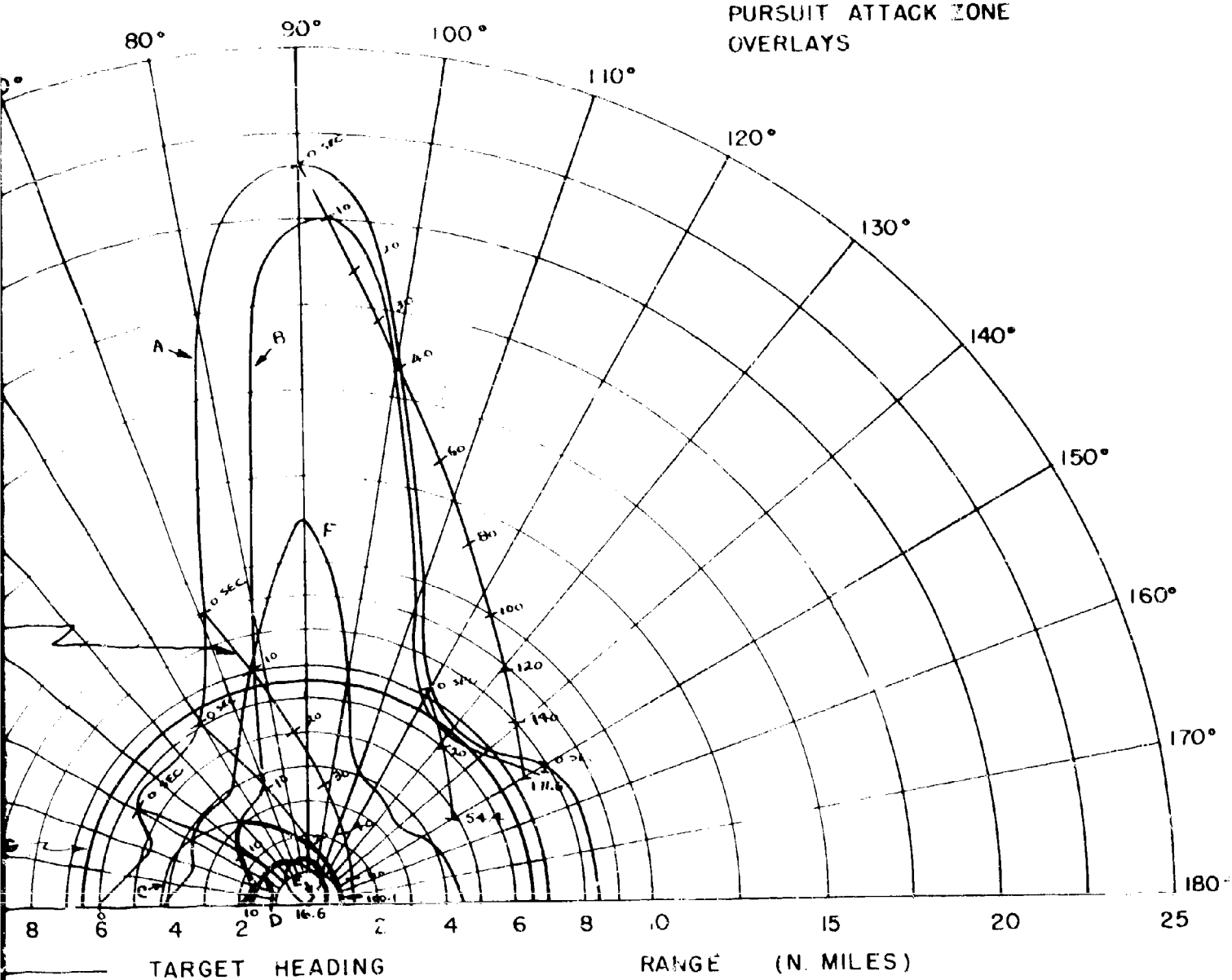


TARGET HEADING

V_E = 1189 FT/SEC (F4H-1)(F8U-3)
V_T = 1189 FT/SEC
ALTITUDE = 1000 FT.

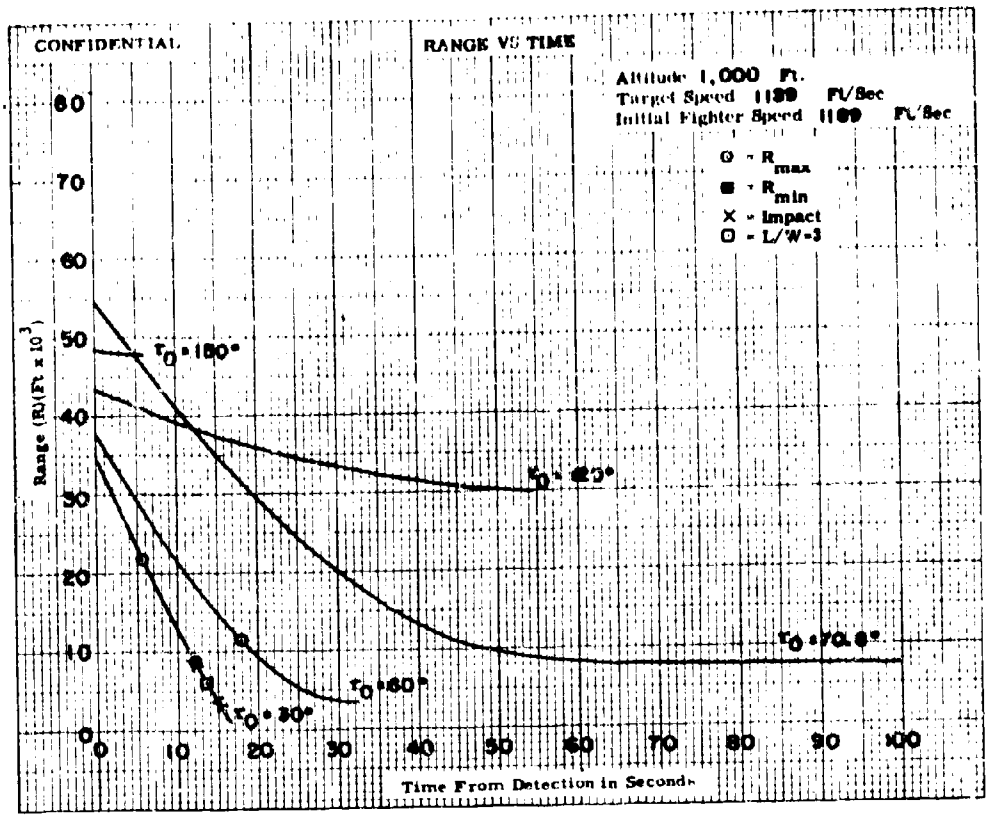
A - 85% DETECTION RANGE
B - LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
C - SPARROW III MAX. AERODYNAMIC RANGE
D - SPARROW III MIN. AERODYNAMIC RANGE
E - CONSTANT LOAD FACTOR LOCUS (N_Z = 3)
F - 90% SPARROW III SEEKER LOCK-ON RANGE
G - 6.5 N.M. INTERLOCK

FIG. III - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS



85% DETECTION RANGE
LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
SPARROW III MAX. AERODYNAMIC RANGE
SPARROW III MIN. AERODYNAMIC RANGE
CONSTANT LOAD FACTOR LOCUS ($N_Z = 3$)
90% SPARROW III SEEKER LOCK-ON RANGE
6.5 N.M. INTERLOCK

CONFIDENTIAL


CONFIDENTIAL
RANGE VS TIME
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
⊙ = R_{max}
■ = R_{min}
× = Impact
□ = L/W=3
Range (R)(Ft x 10^3)
τ_0 = 180°
τ_0 = 120°
τ_0 = 90°
τ_0 = 60°
τ_0 = 30°
Time From Detection in Seconds

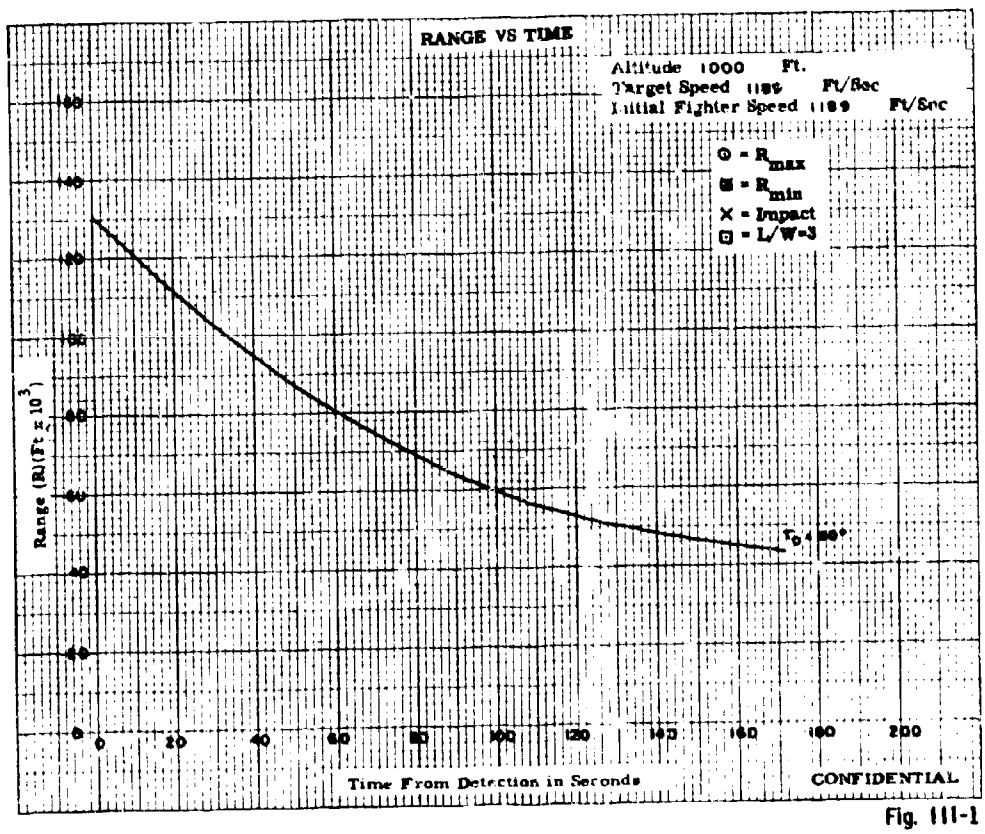
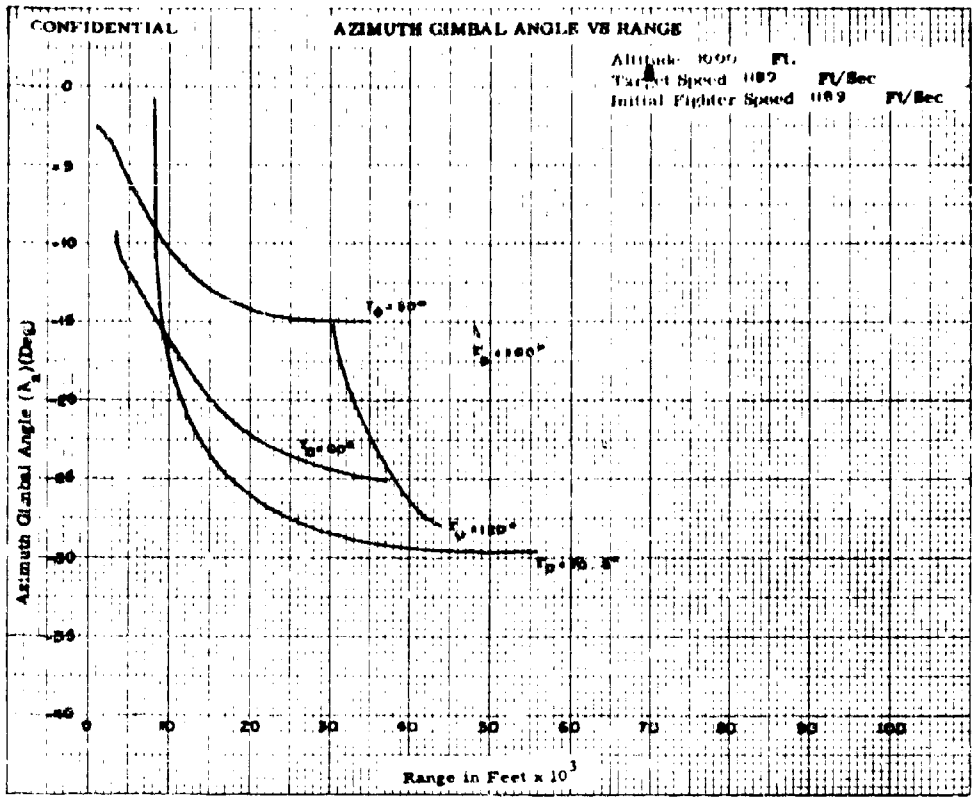

RANGE VS TIME
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
⊙ = R_{max}
■ = R_{min}
× = Impact
□ = L/W=3
Range (R)(Ft x 10^3)
τ_0 = 90°
Time From Detection in Seconds
CONFIDENTIAL

Fig. III-1


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azimuth Gimbal Angle (A_z)(Deg)
Range in Feet x 10^3

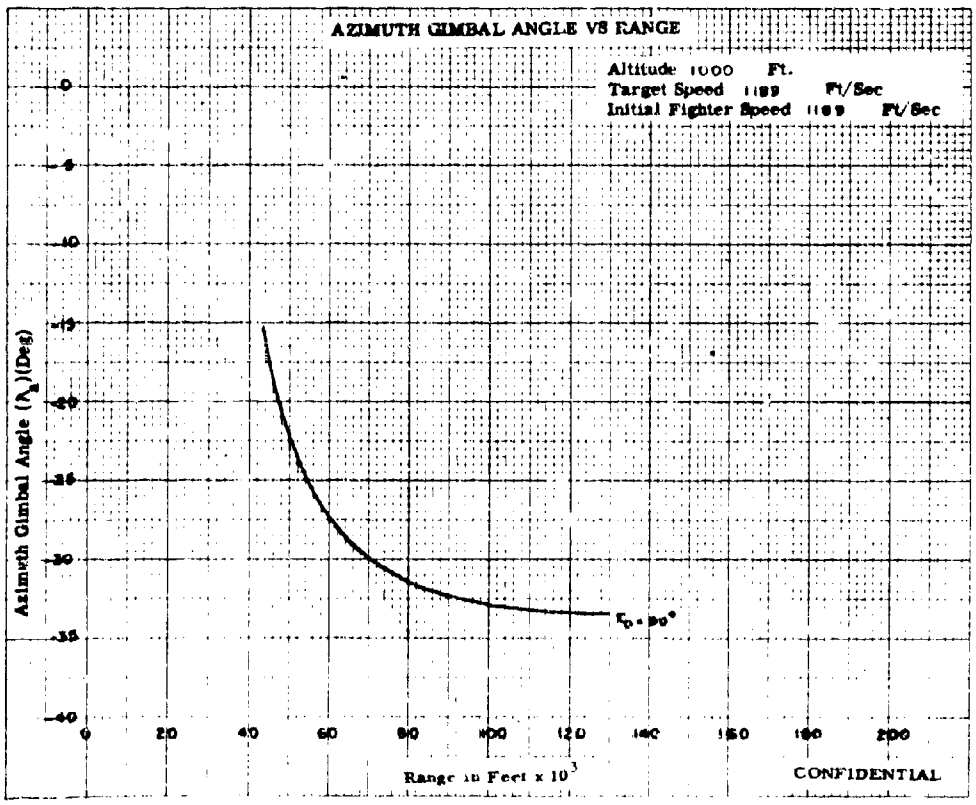
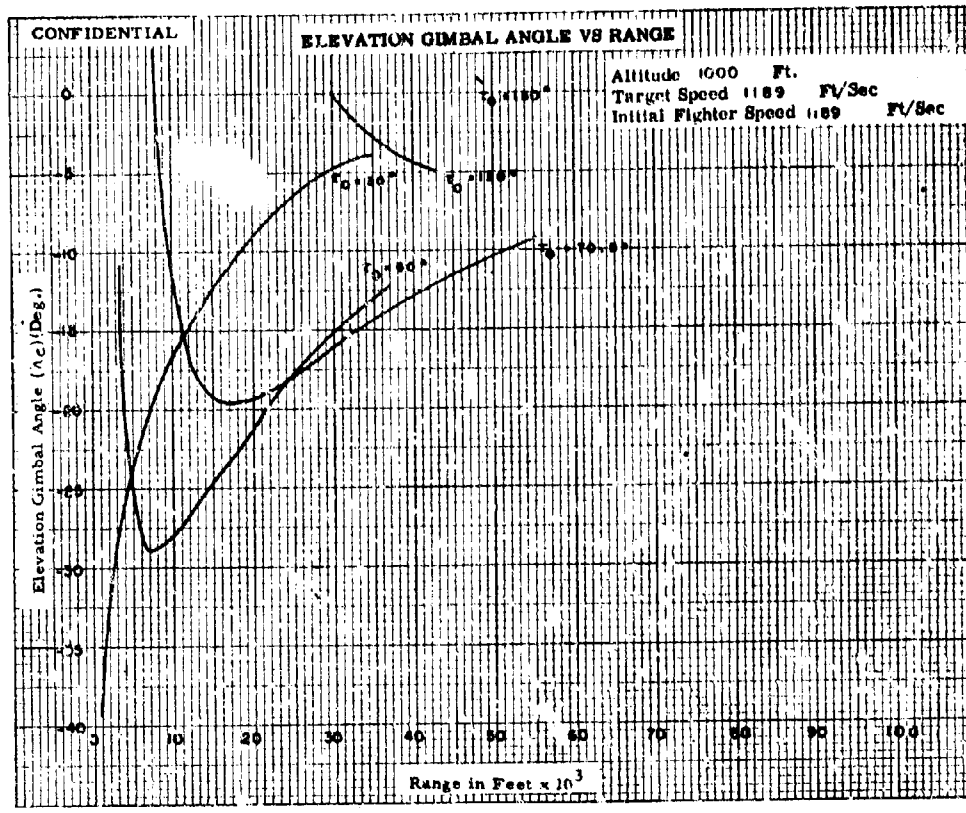

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azimuth Gimbal Angle (A_z)(Deg)
Range in Feet x 10^3
CONFIDENTIAL

Fig. III-2


CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Gimbal Angle (Λ_e)(Deg.)
Range in Feet x 10^3

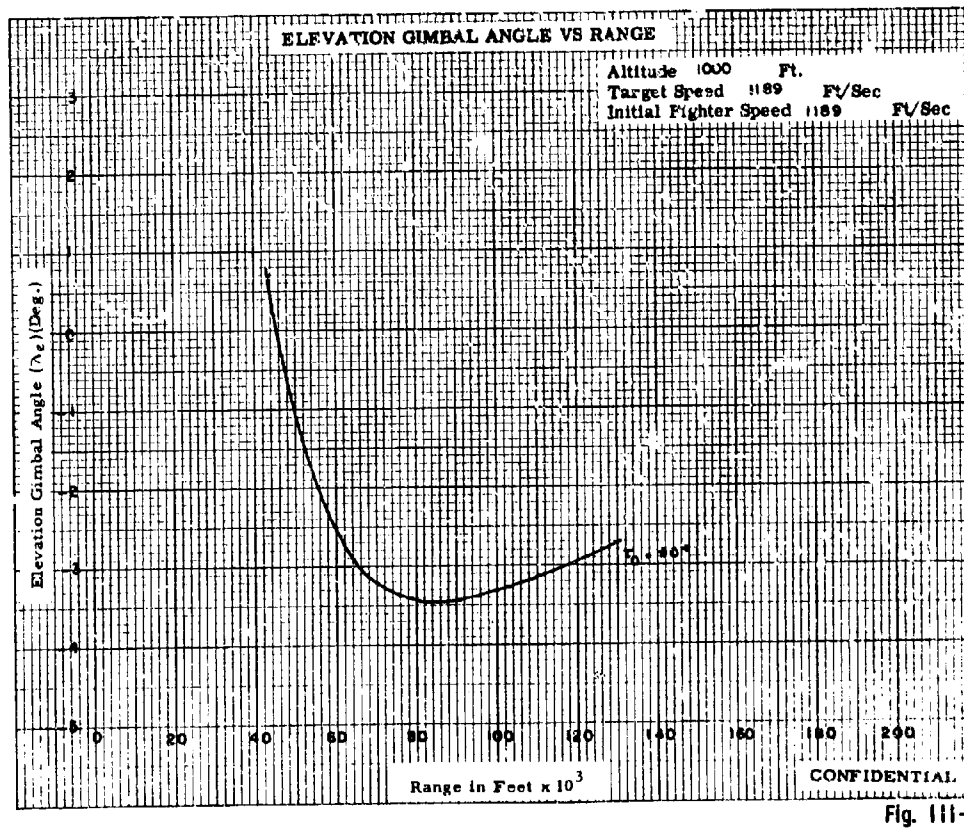
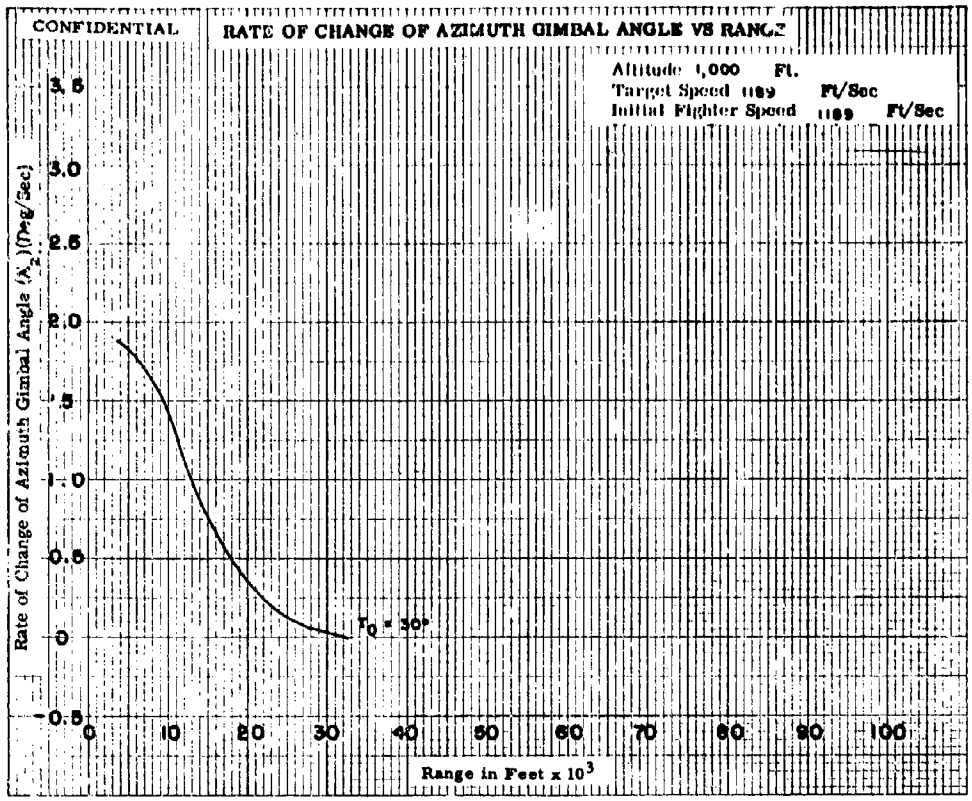

ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Gimbal Angle (Λ_e)(Deg.)
Range in Feet x 10^3
CONFIDENTIAL

Fig. III-3


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{A}_2$) (Deg/Sec)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
γ_0 = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

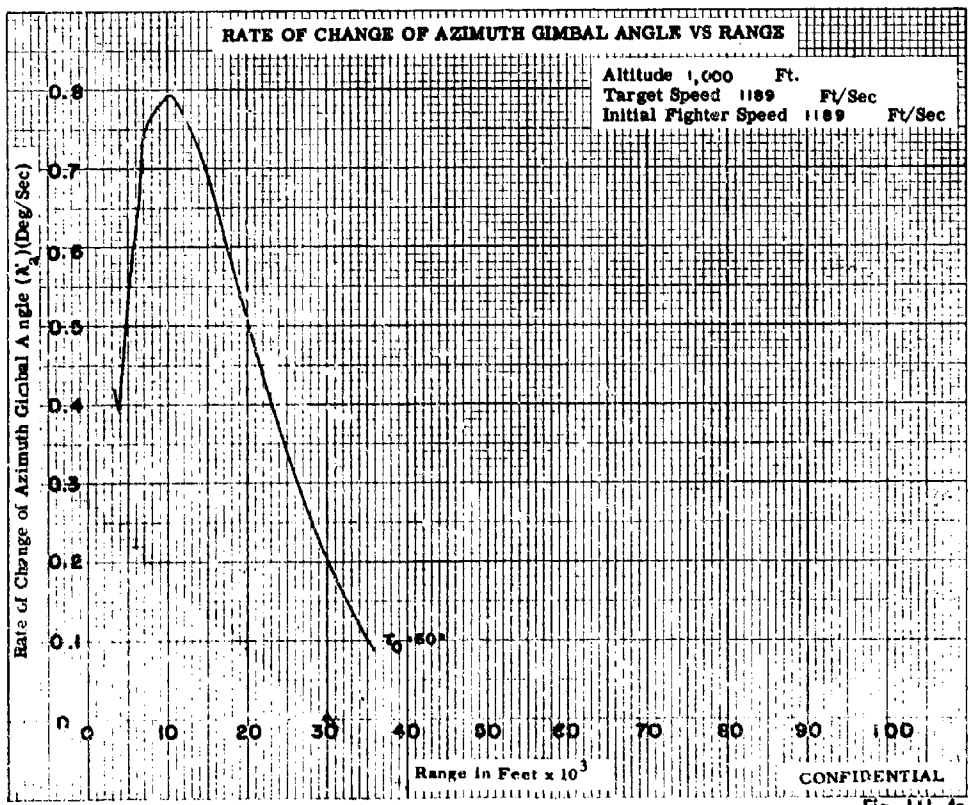
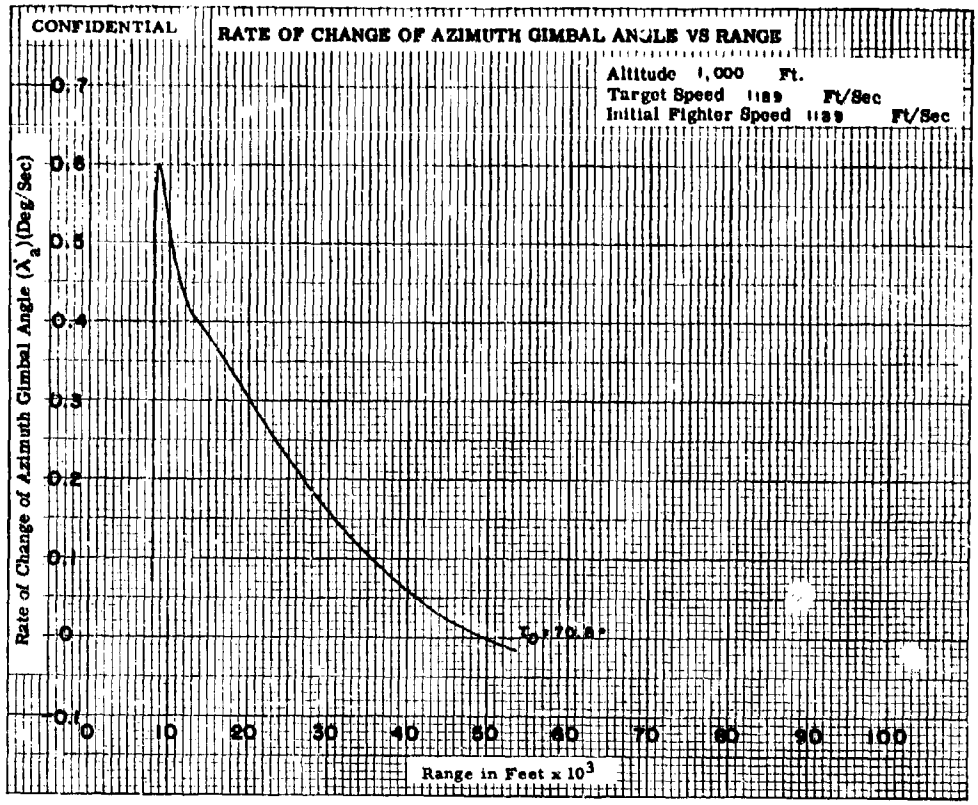

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{A}_2$) (Deg/Sec)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
γ_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. III-4a


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
$\gamma_0 = 70.8°$
0 10 20 30 40 50 60 70 80 90 100
Range in Feet x 10^3

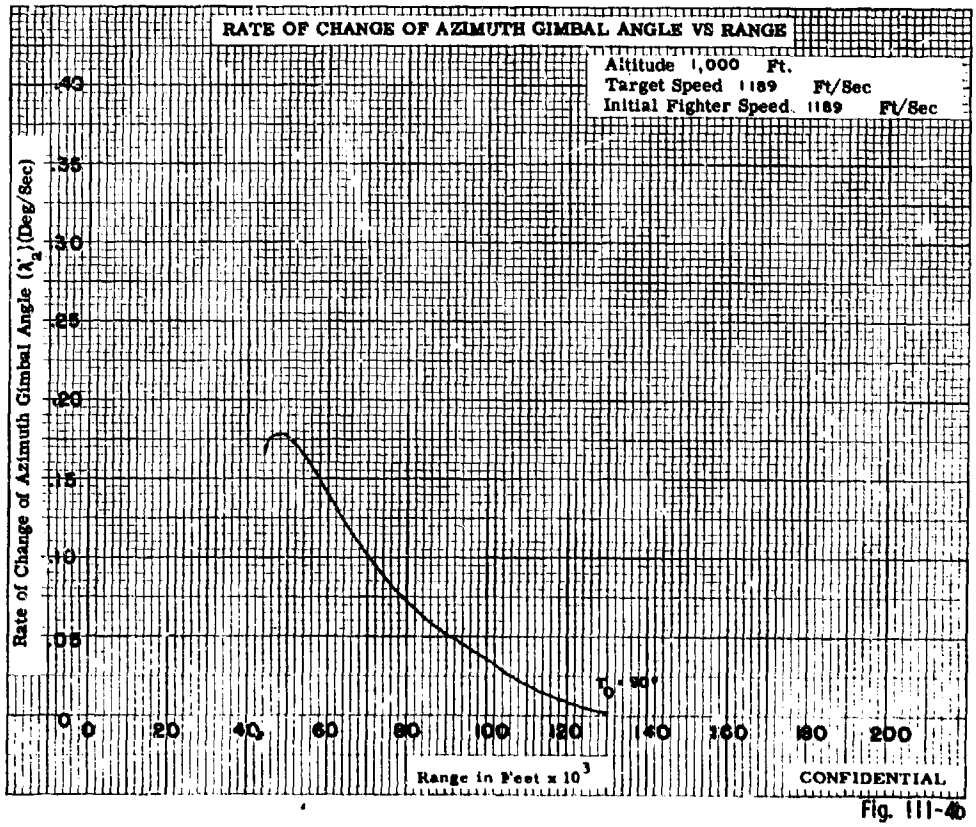

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
.40
.35
.30
.25
.20
.15
.10
.05
0.0
$\gamma_0 = 90°$
0 20 40 60 80 100 120 140 160 180 200
Range in Feet x 10^3
CONFIDENTIAL

Fig. III-40

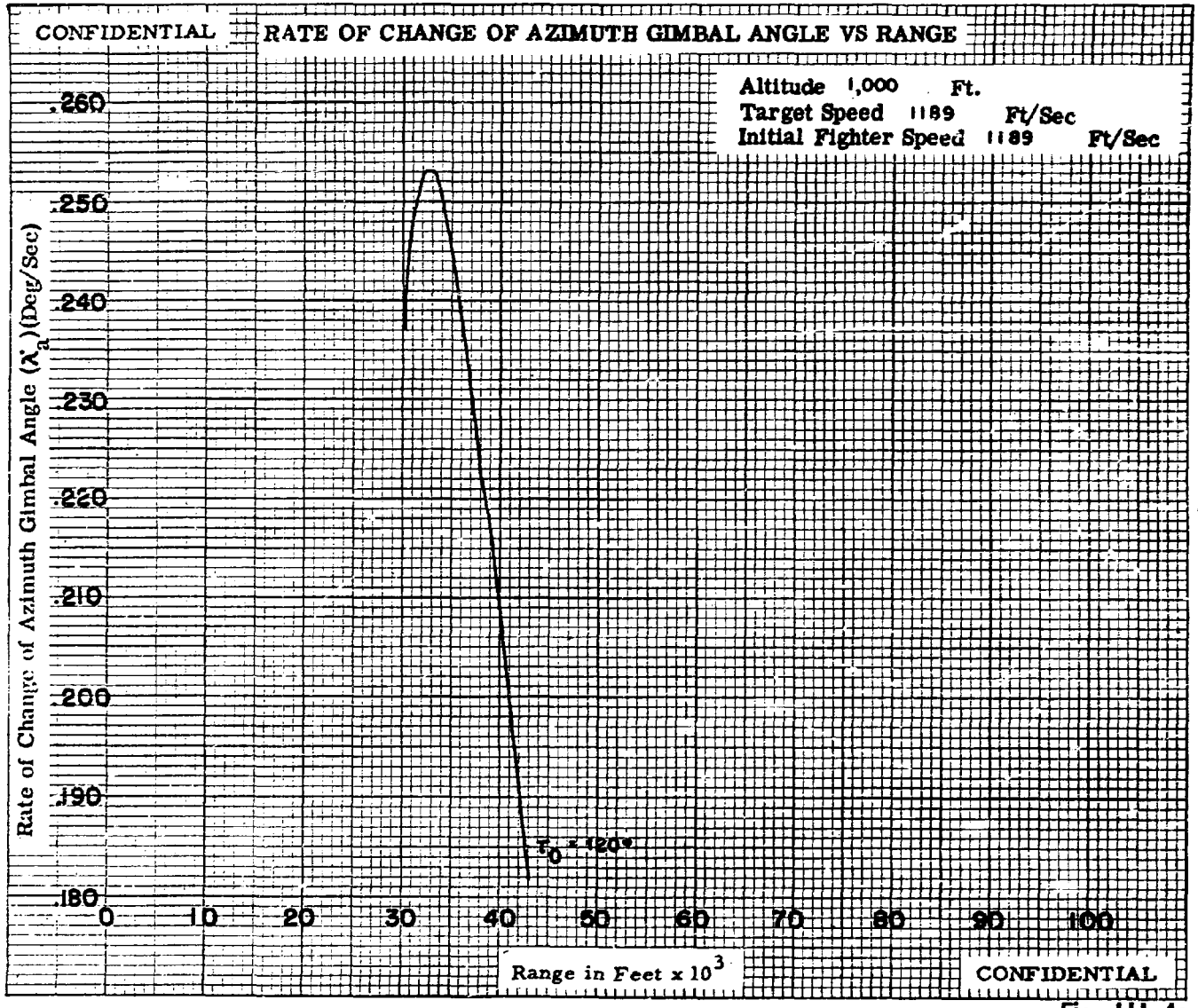
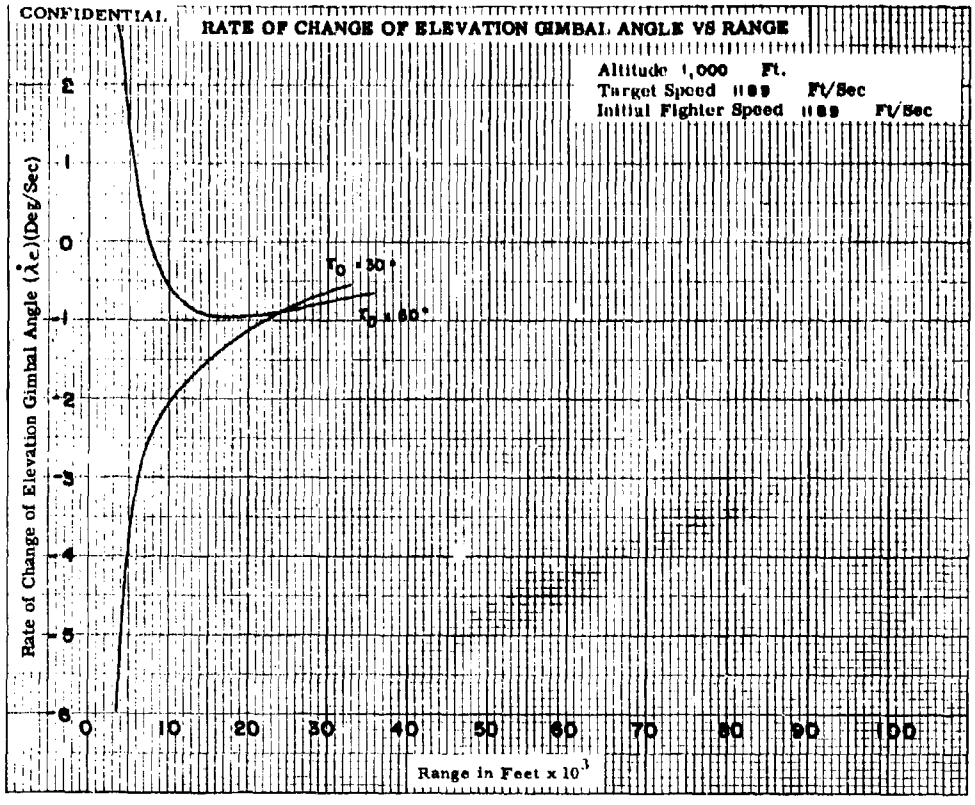

CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_a$) (Deg/Sec)
260
250
240
230
220
210
200
190
180
τ_0 = 120°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. III-4c


RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Elevation Gimbal Angle ($\dot{\lambda}_E$)(Deg/Sec)
2
1
0
-1
-2
-3
-4
-5
-6
τ_0 = 30°
τ_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

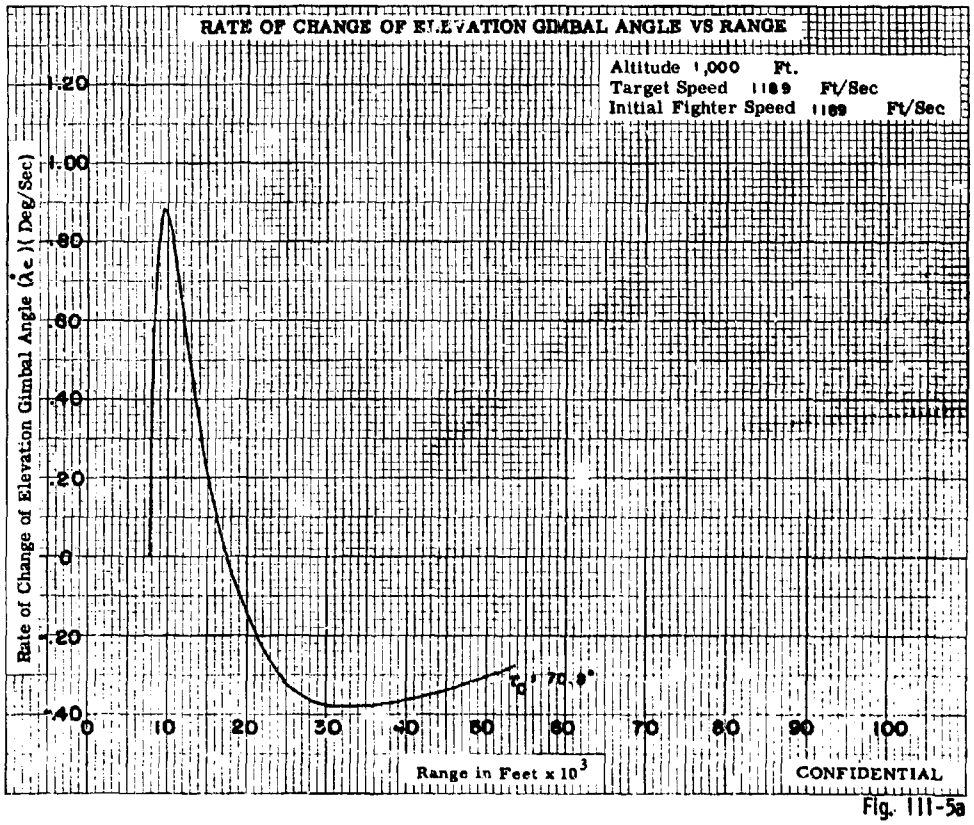
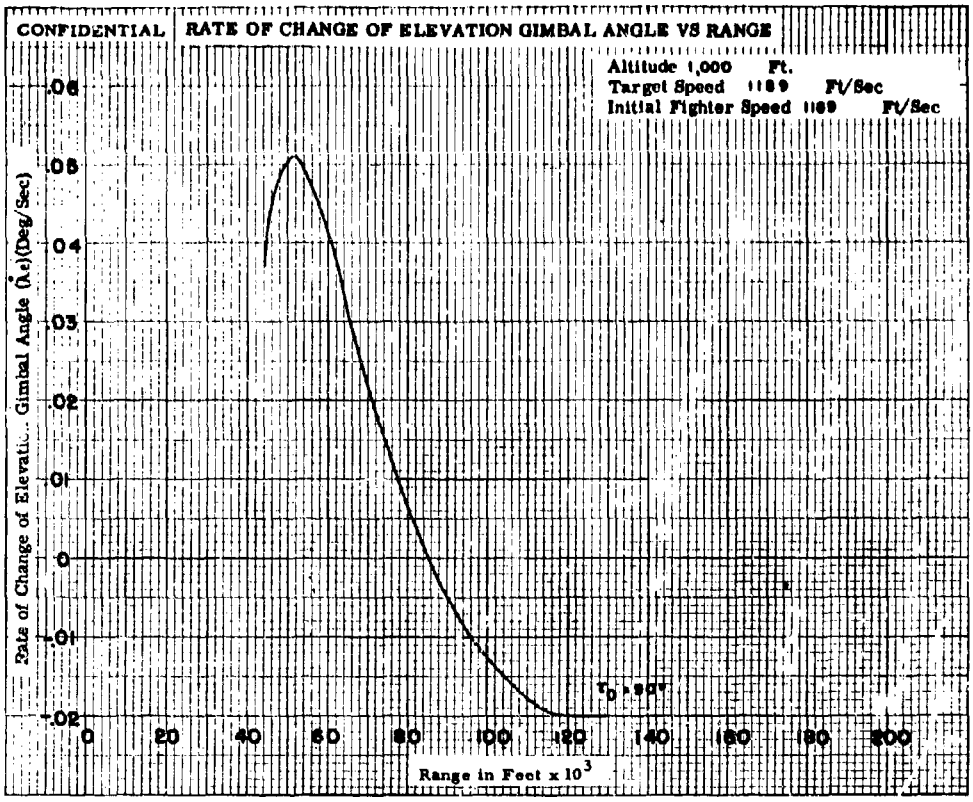

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Elevation Gimbal Angle ($\dot{\lambda}_E$)(Deg/Sec)
1.20
1.00
.80
.60
.40
.20
0
-.20
-.40
τ_0 = 70.9°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

Fig. III-5a


CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
.06
.05
.04
.03
.02
.01
0
-.01
-.02
τ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

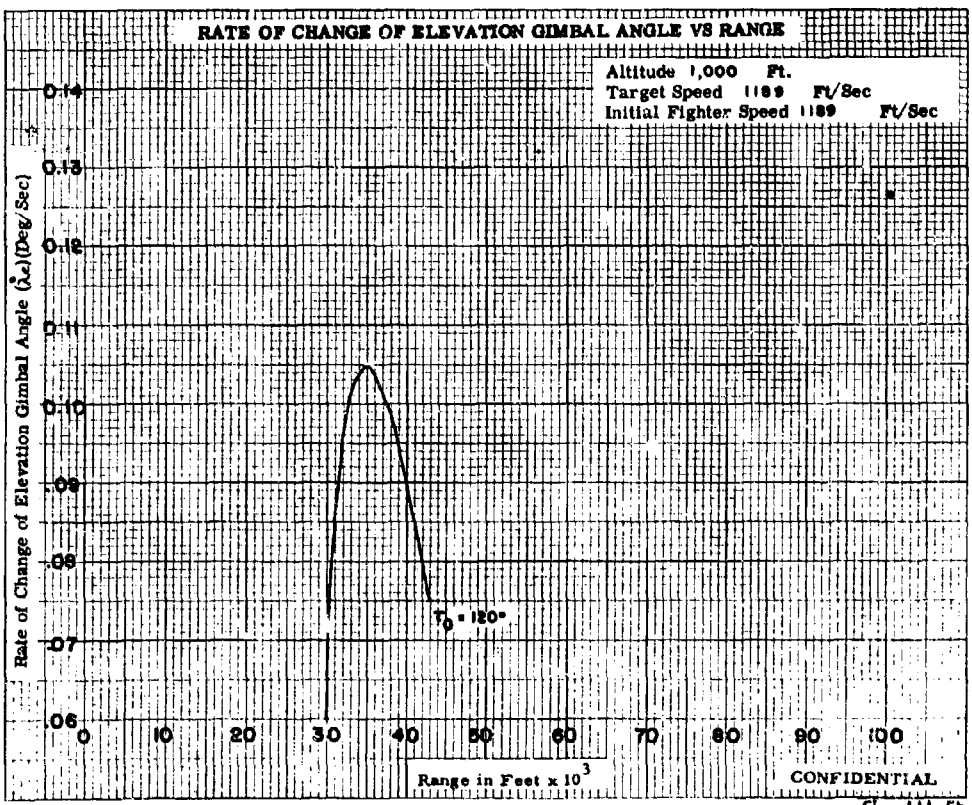
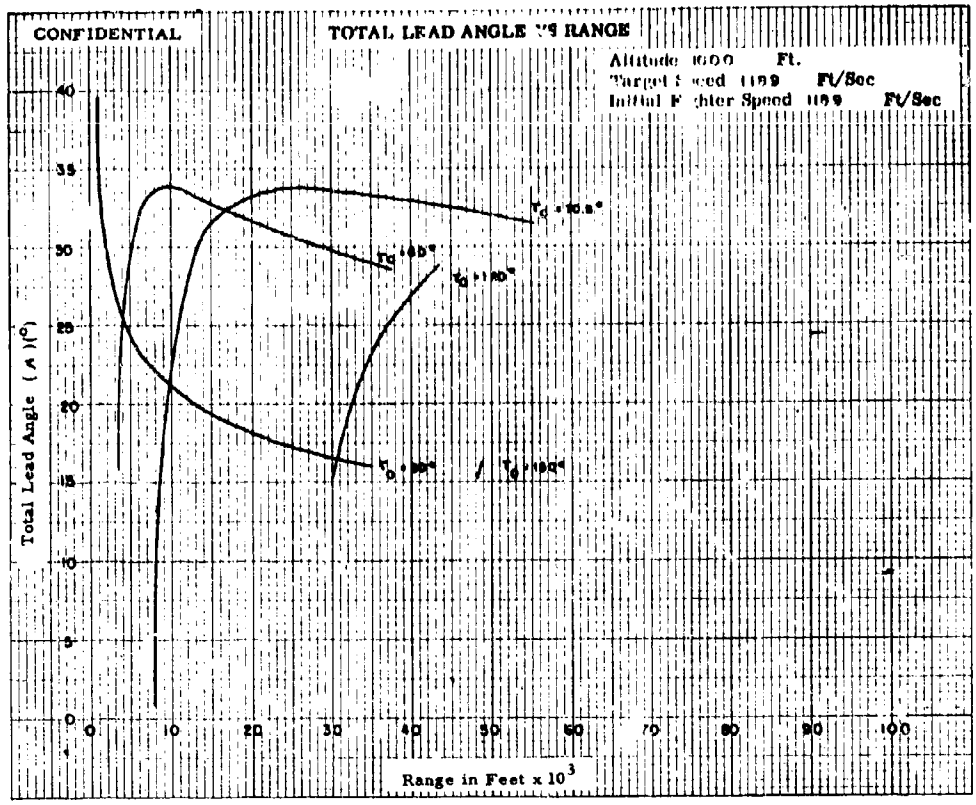

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
0.14
0.13
0.12
0.11
0.10
.09
.08
.07
.06
τ_0 = 120°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. III-5b


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Total Lead Angle (λ)(°)
Range in Feet x 10³

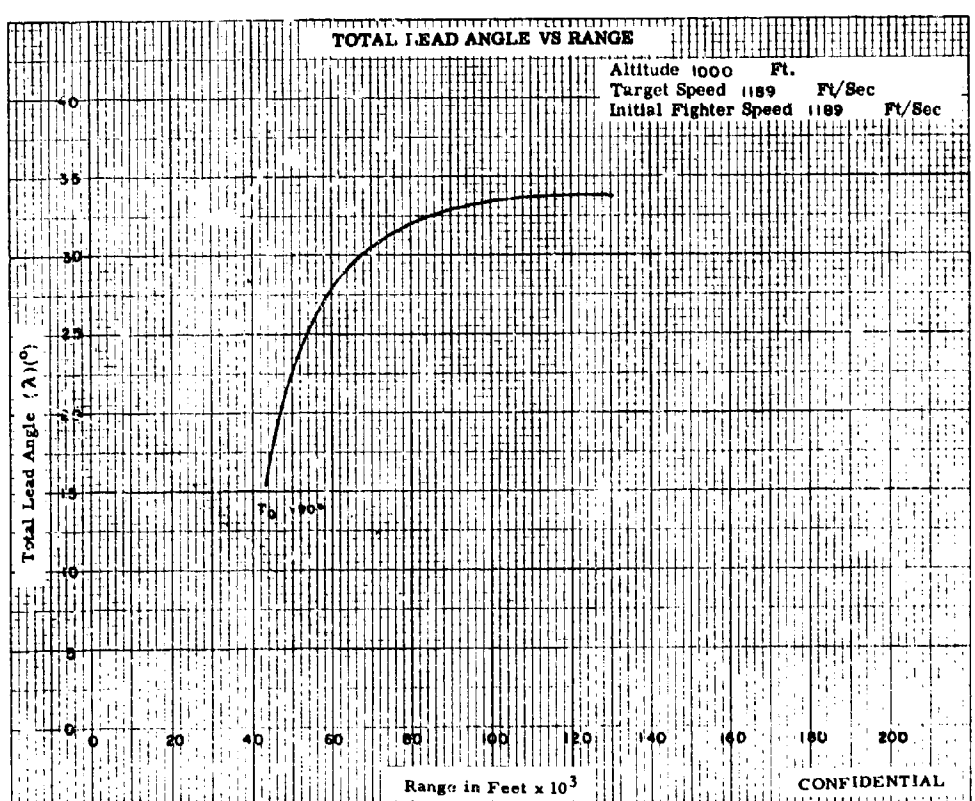
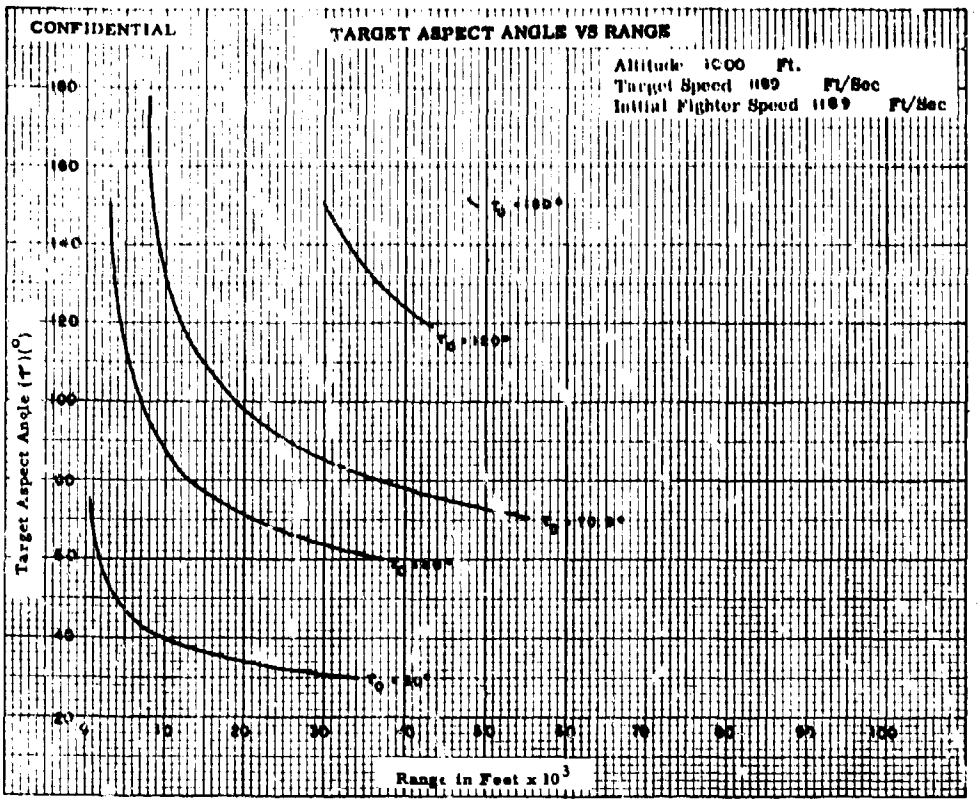

TOTAL LEAD ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Total Lead Angle (λ)(°)
Range in Feet x 10³
CONFIDENTIAL

Fig. III-6


CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Target Aspect Angle (τ)(°)
Range in Feet x 10³

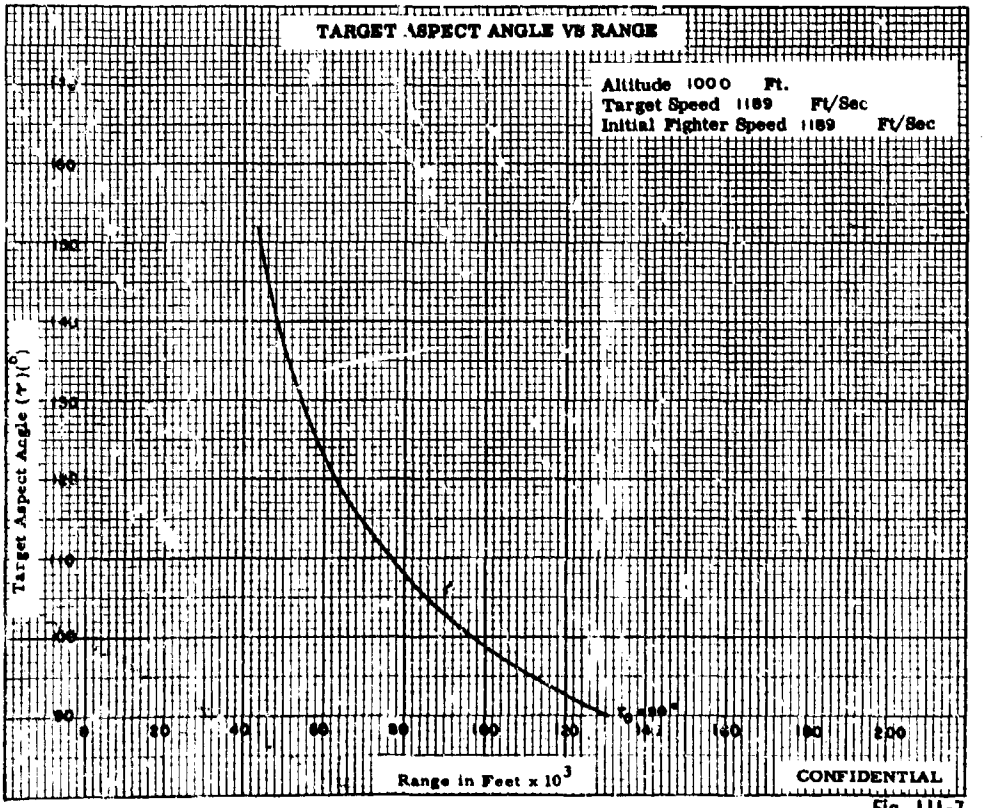
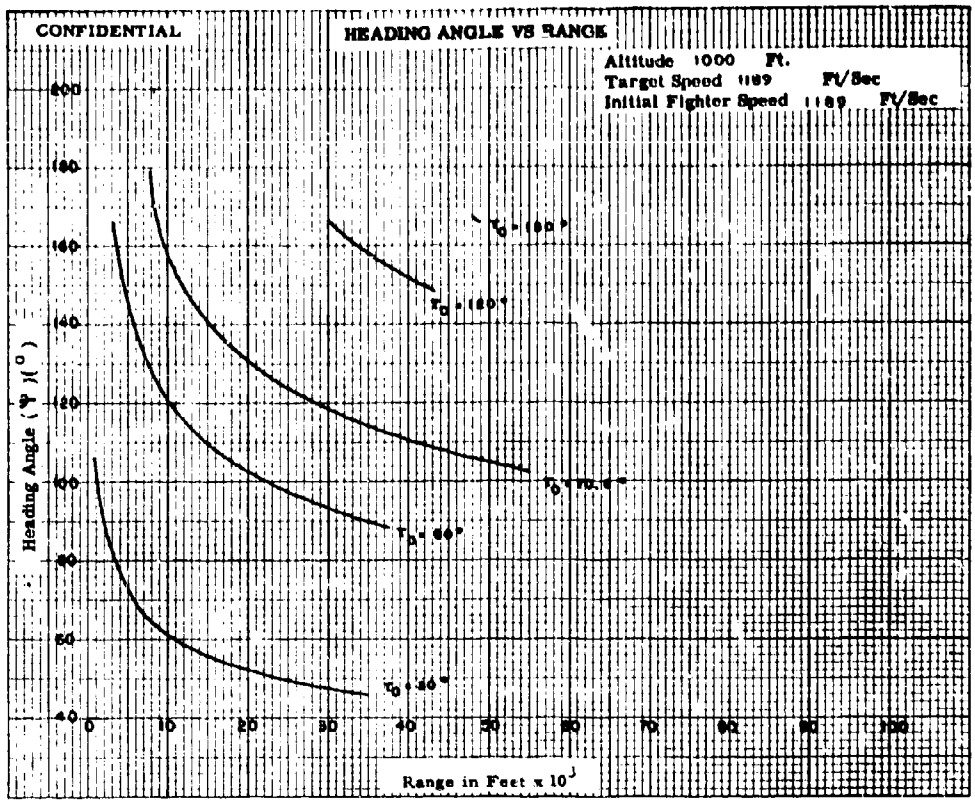

TARGET ASPECT ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Target Aspect Angle (τ)(°)
Range in Feet x 10³
CONFIDENTIAL

Fig. III-7


CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Heading Angle (Ψ)(°)
Range in Feet x 10³
0
10
20
30
40
50
60
70
80
90
100
40
60
80
100
120
140
160
180
200

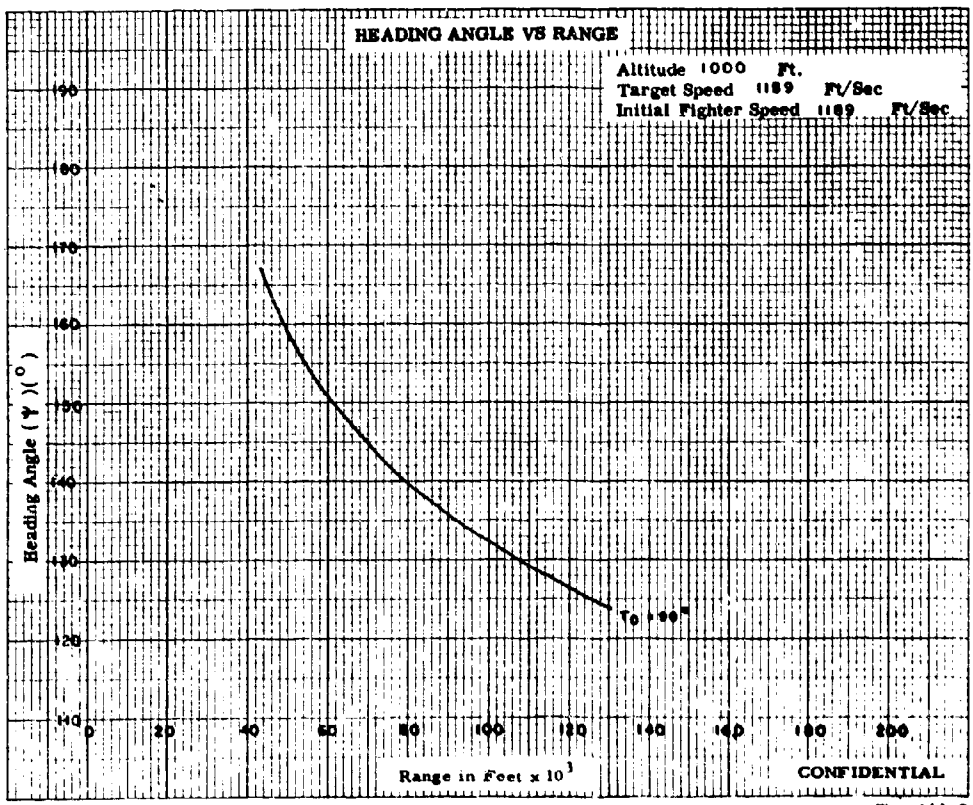
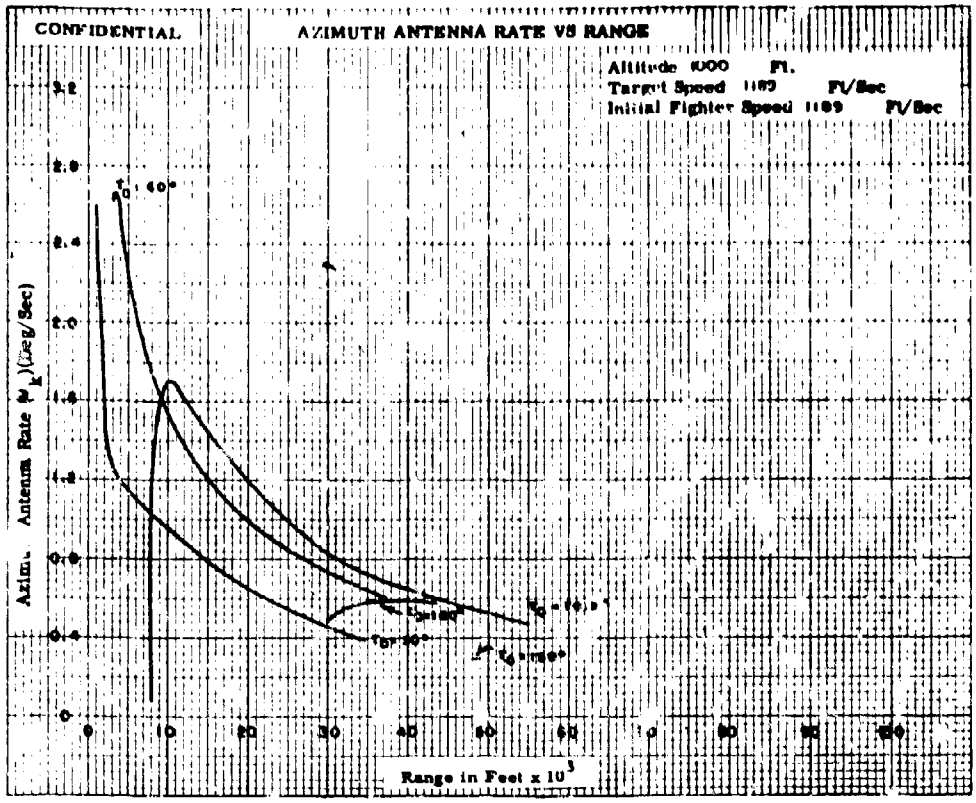

HEADING ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Heading Angle (Ψ)(°)
Range in Feet x 10³
0
20
40
60
80
100
120
140
160
180
200
CONFIDENTIAL

Fig. III-8


CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azim. Antenna Rate ($\dot{\mu}_k$)(Deg/Sec)
Range in Feet x 10^3

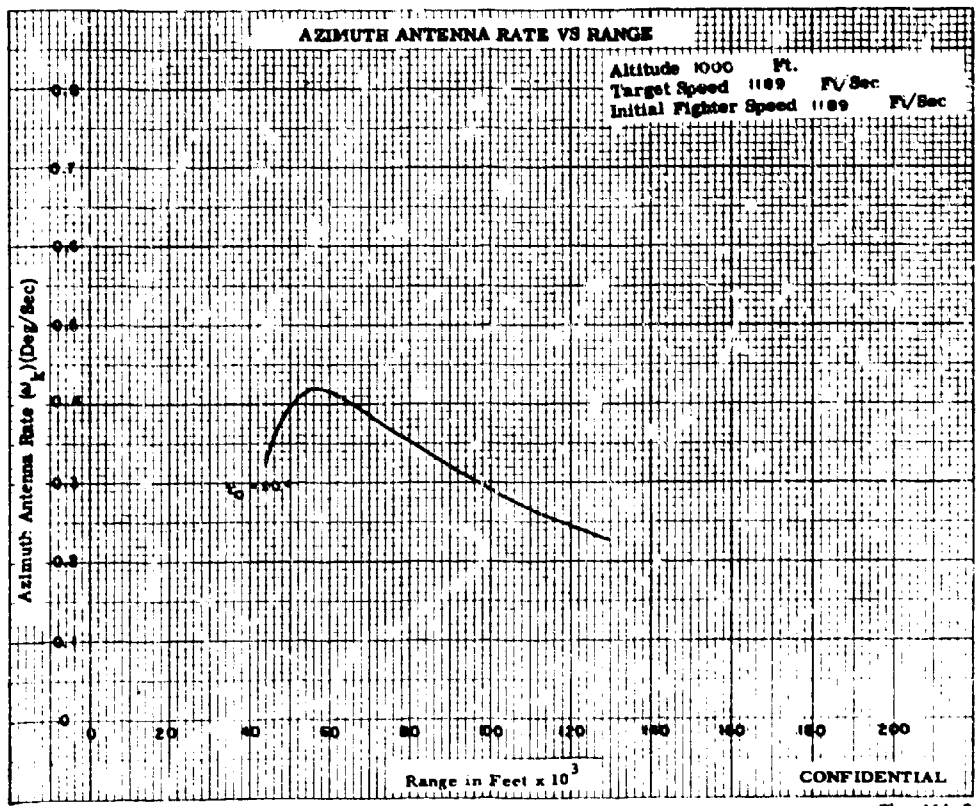
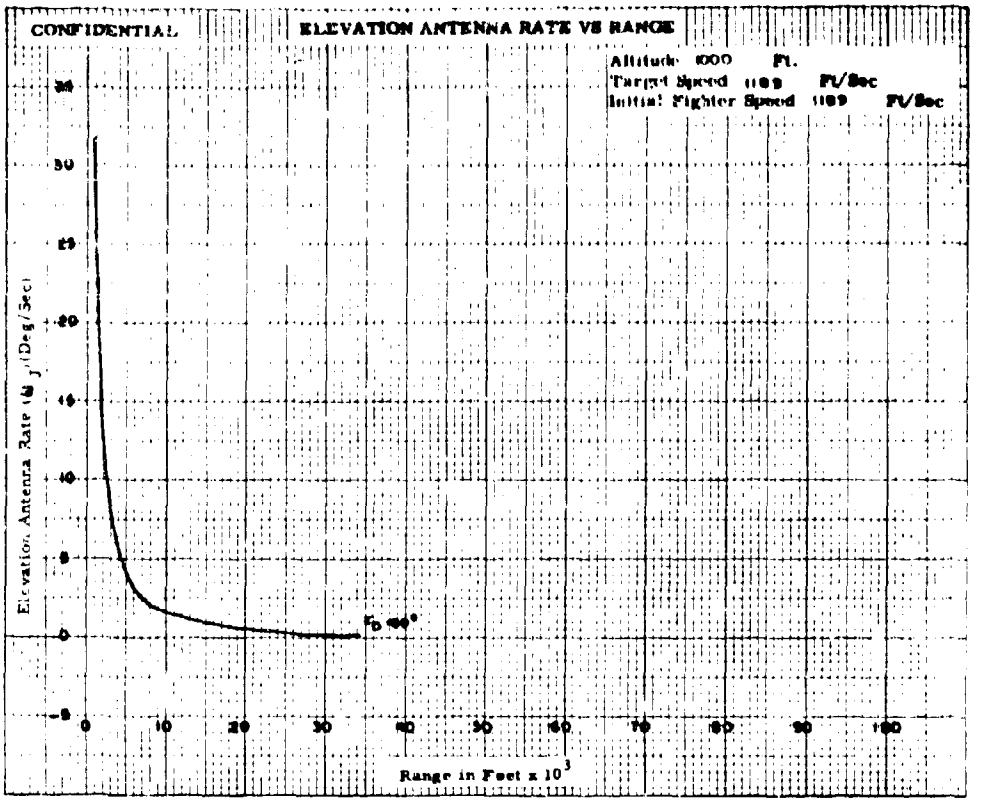

AZIMUTH ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azimuth Antenna Rate ($\dot{\mu}_k$)(Deg/Sec)
Range in Feet x 10^3
CONFIDENTIAL

Fig. 11-9


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ω)y (Deg/Sec)
Range in Feet x 10^3

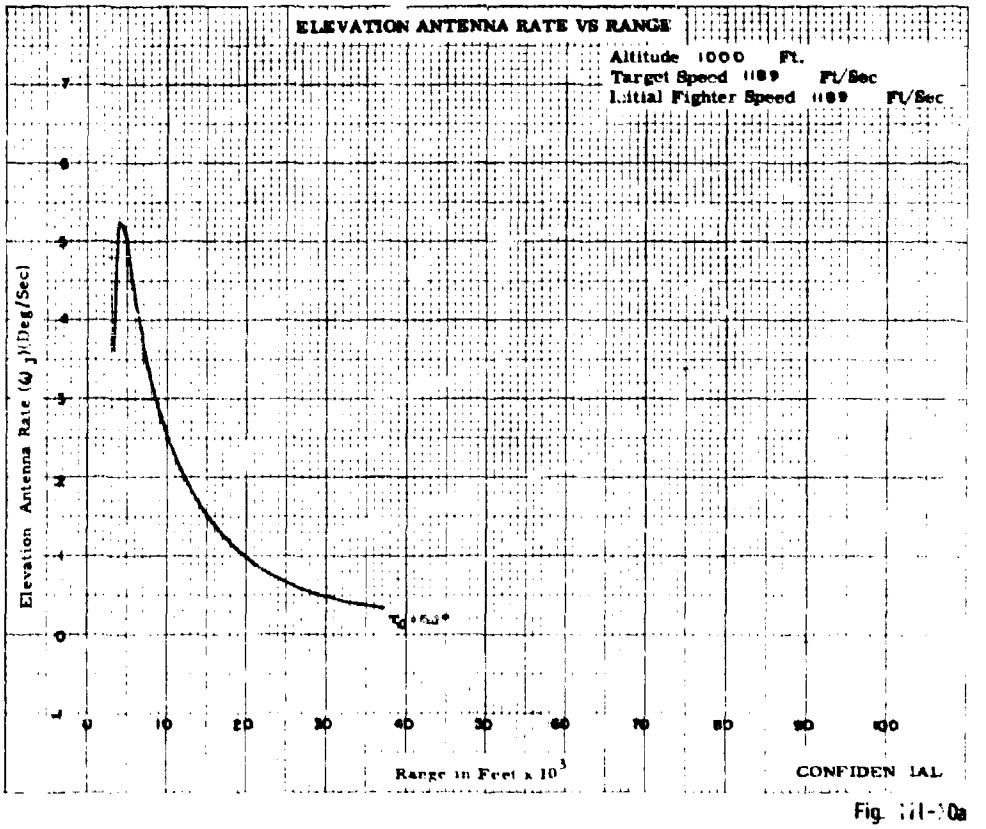
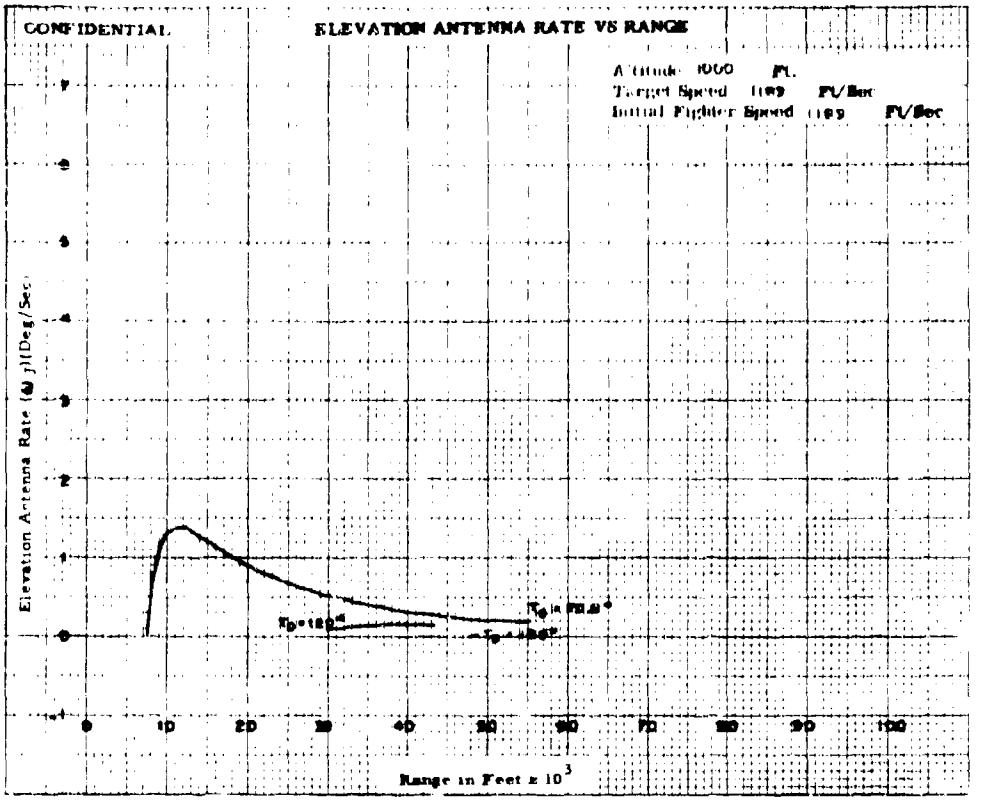

ELEVATION ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ω)y (Deg/Sec)
Range in Feet x 10^3
CONFIDENTIAL

Fig. 7.1-10a


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ω_y) (Deg/Sec)
Range in Feet x 10^3

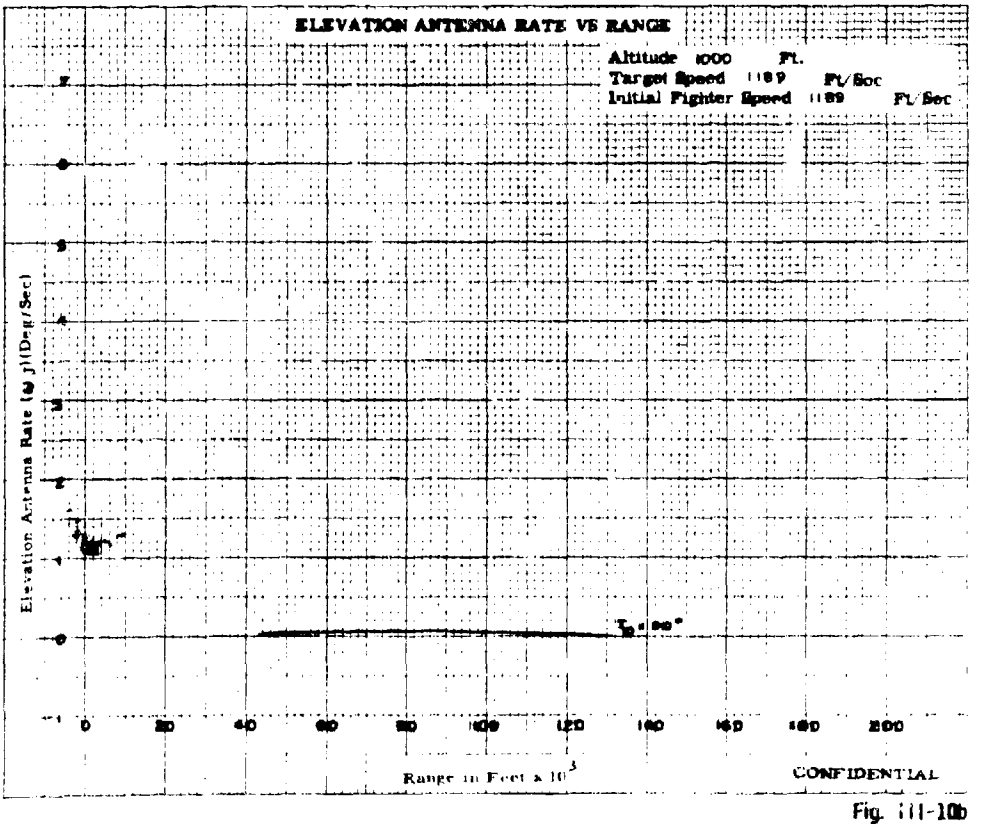

ELEVATION ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ω_y) (Deg/Sec)
Range in Feet x 10^3
CONFIDENTIAL

Fig. III-10b

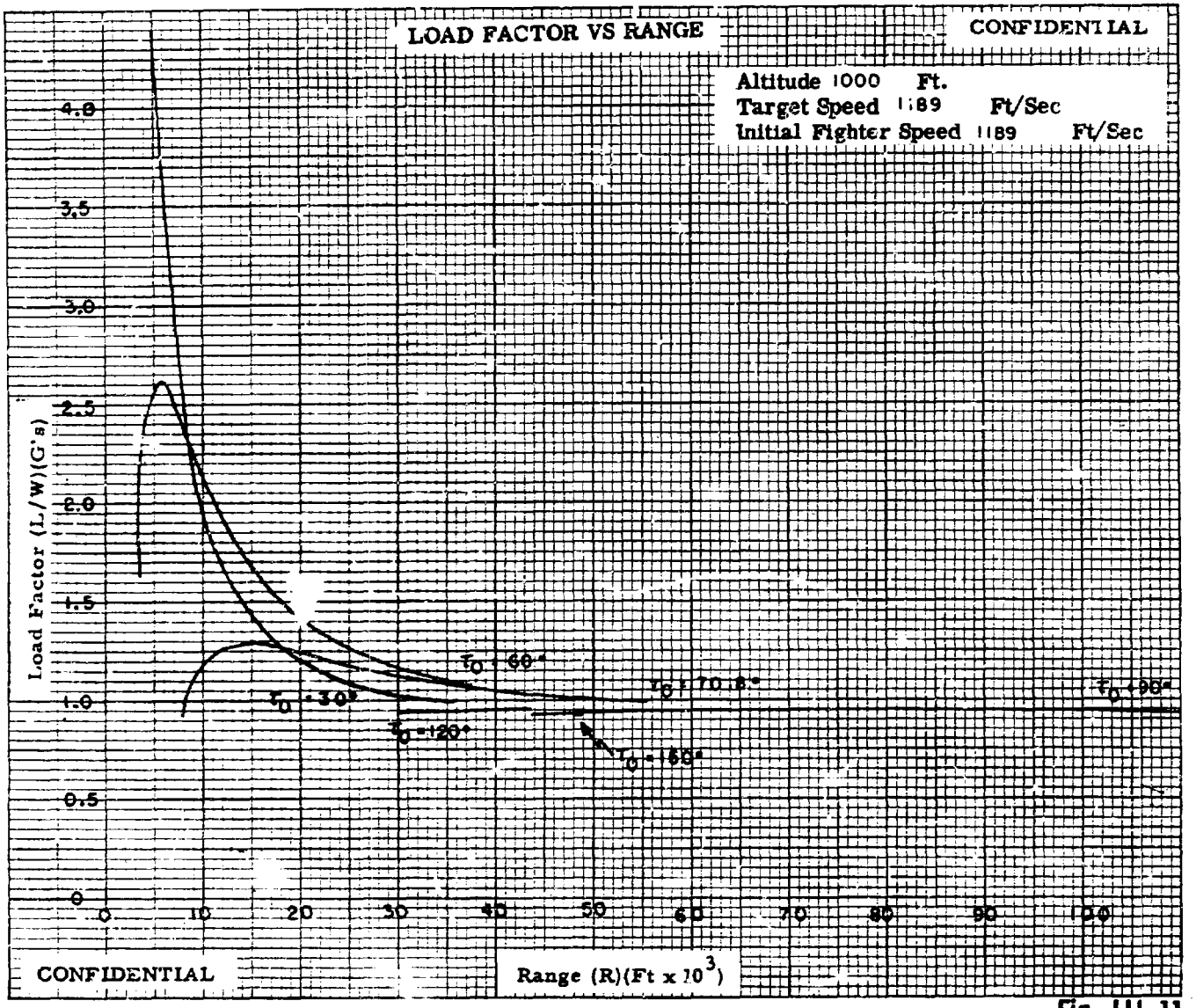
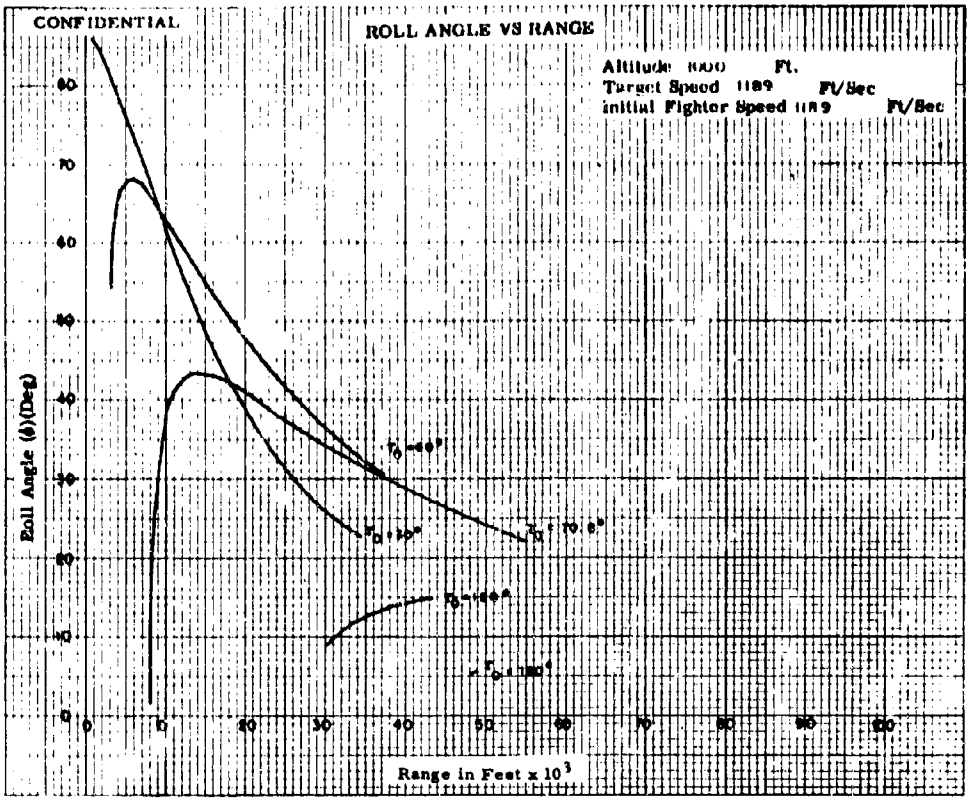

LOAD FACTOR VS RANGE
CONFIDENTIAL
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Load Factor (L/W)(G's)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
10
20
30
40
50
60
70
80
90
100
T_0 = 60°
T_0 = 70.8°
T_0 = 90°
T_0 = 30°
T_0 = 120°
T_0 = 150°
CONFIDENTIAL
Range (R)(Ft x 10^3)

Fig. III-11


CONFIDENTIAL
ROLL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Roll Angle (ϕ)(Deg)
Range in Feet x 10³

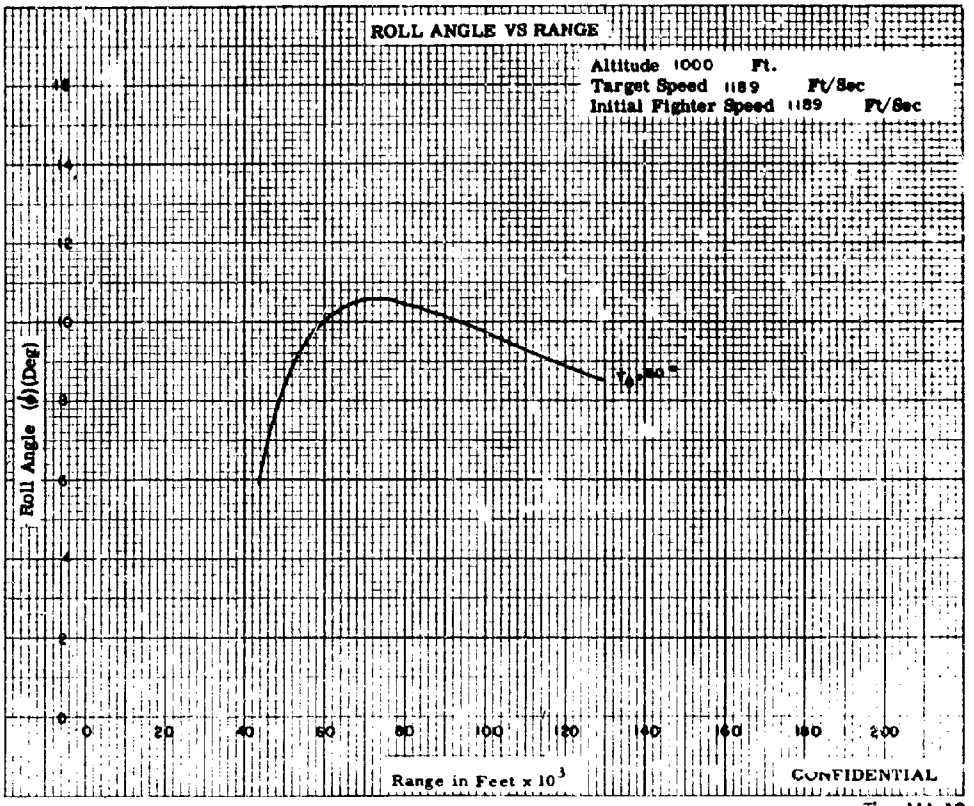
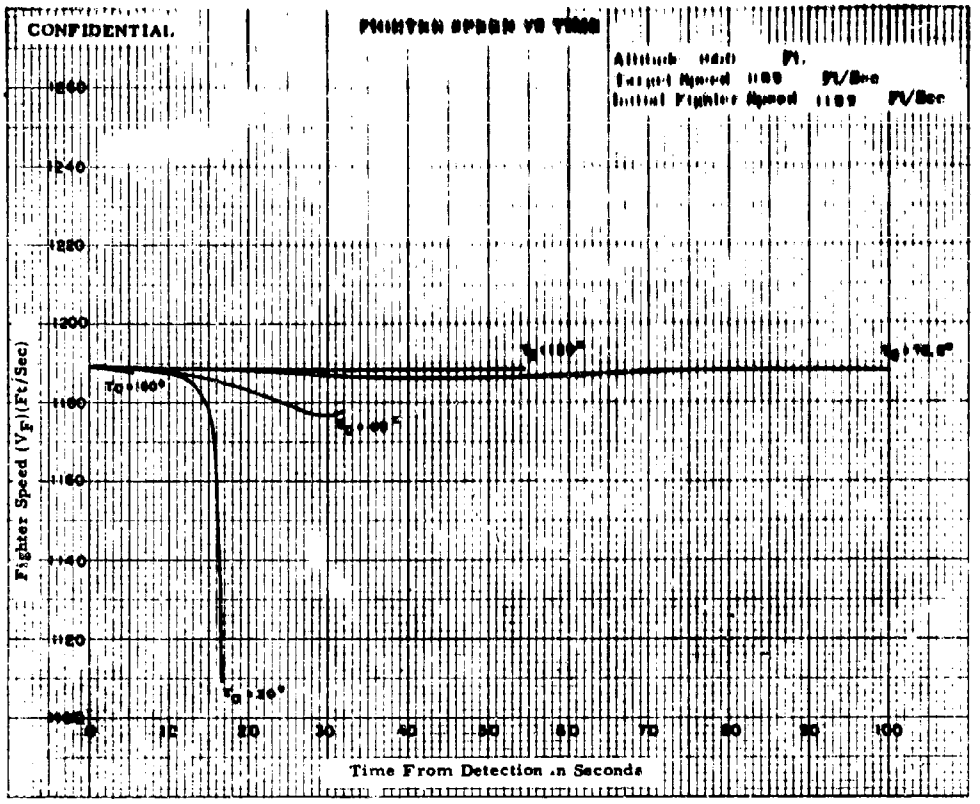

ROLL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Roll Angle (ϕ)(Deg)
Range in Feet x 10³
CONFIDENTIAL

Fig. III-12


CONFIDENTIAL
Altitude (Msl) Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Fighter Speed (V_F)(Ft/Sec)
Time From Detection in Seconds

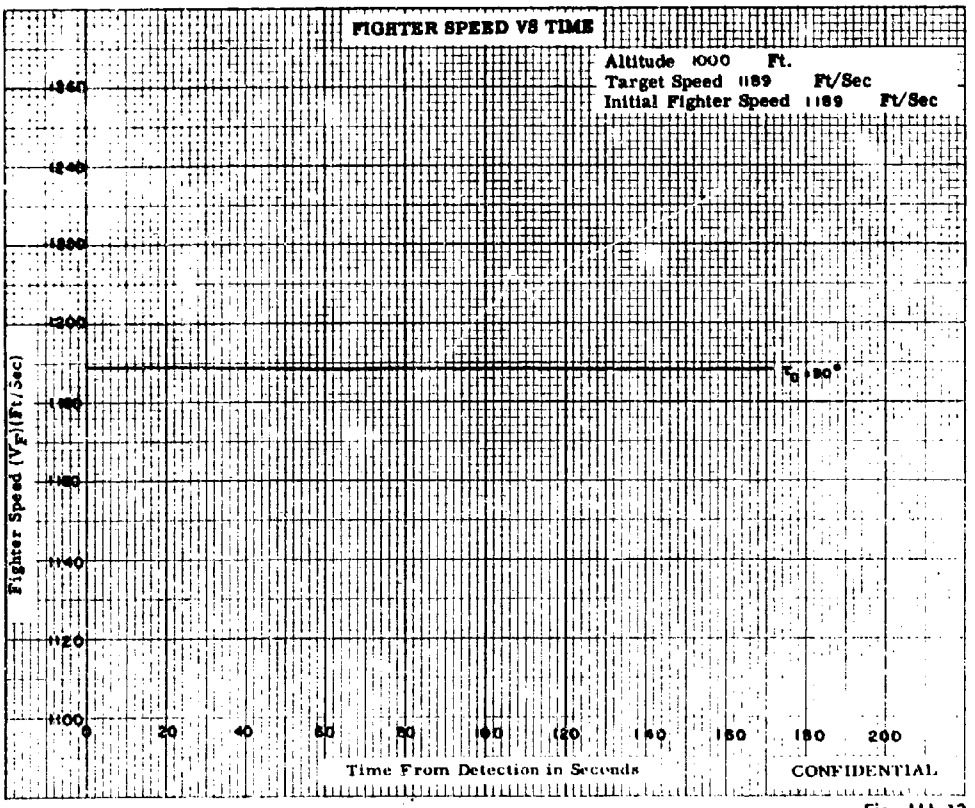
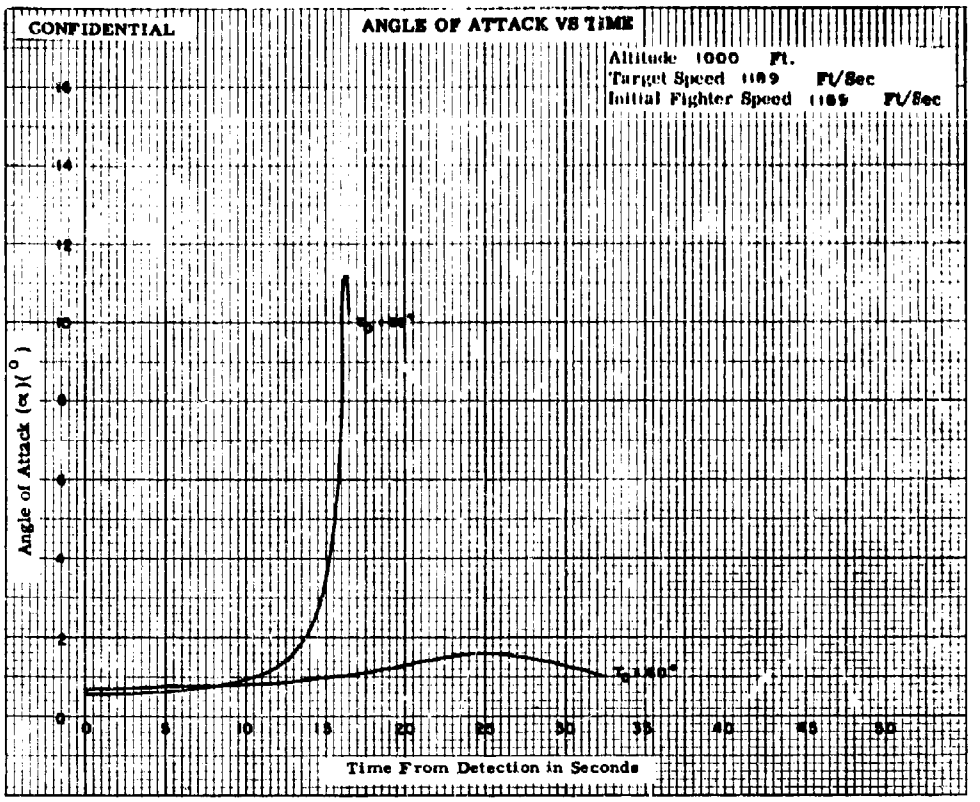

FIGHTER SPEED VS TIME
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Fighter Speed (V_F)(Ft/Sec)
Time From Detection in Seconds
CONFIDENTIAL

Fig. III-13


CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Angle of Attack (α)(°)
Time From Detection in Seconds

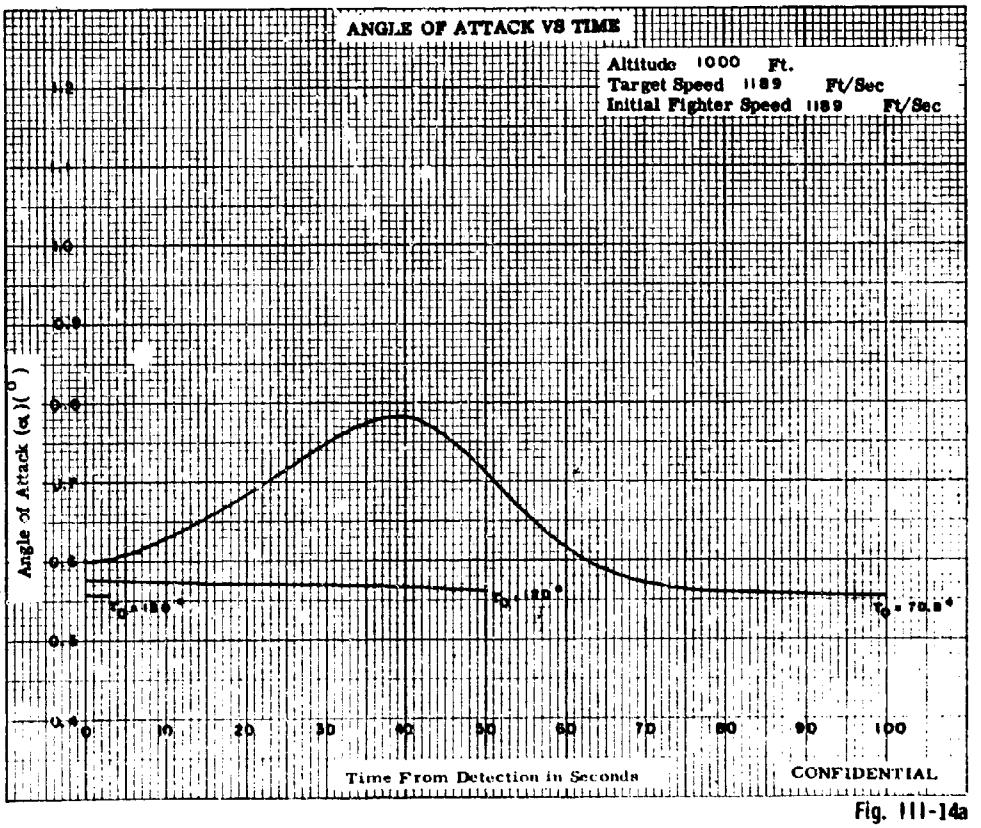

ANGLE OF ATTACK VS TIME
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Angle of Attack (α)(°)
Time From Detection in Seconds
CONFIDENTIAL

Fig. III-14a

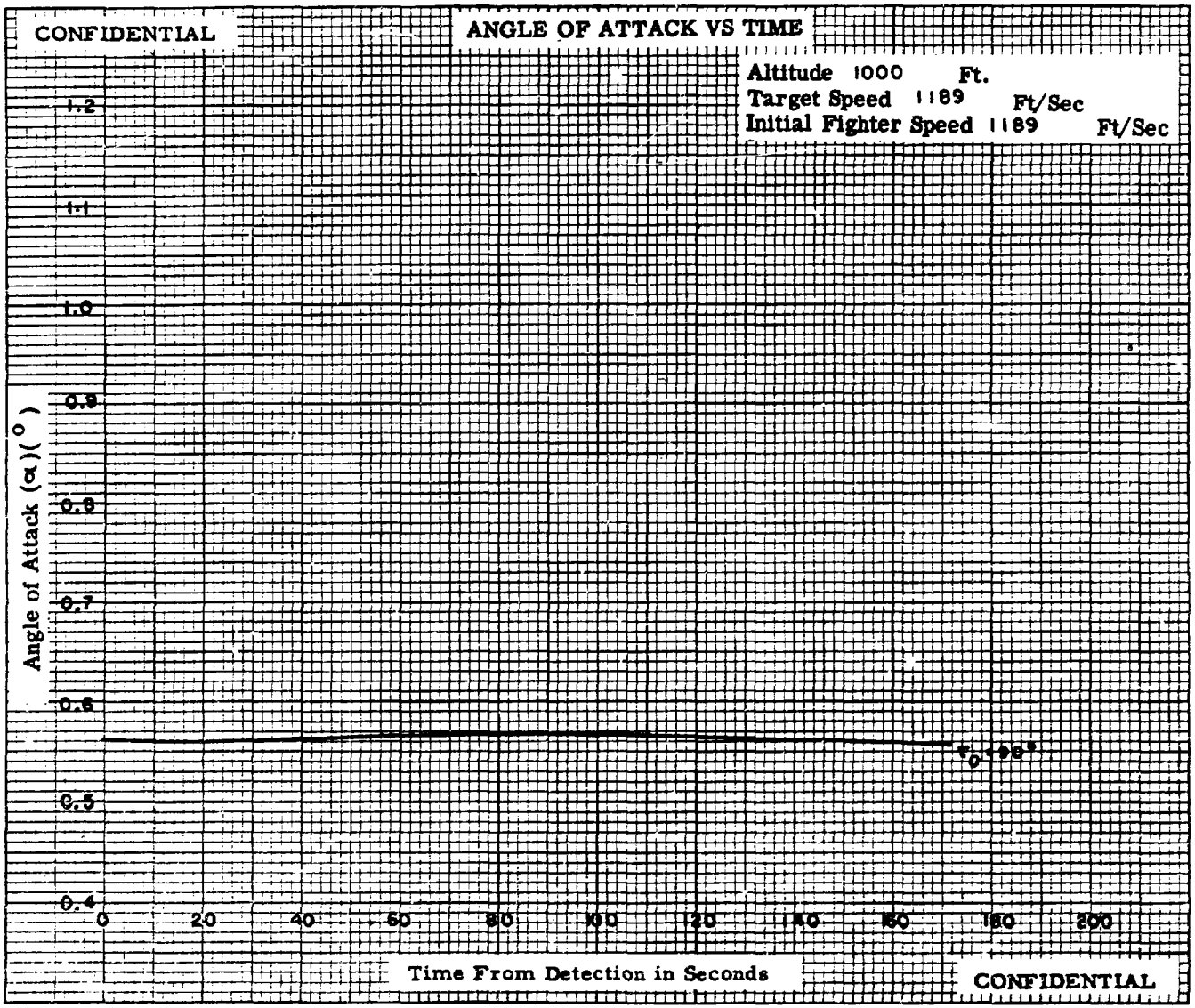
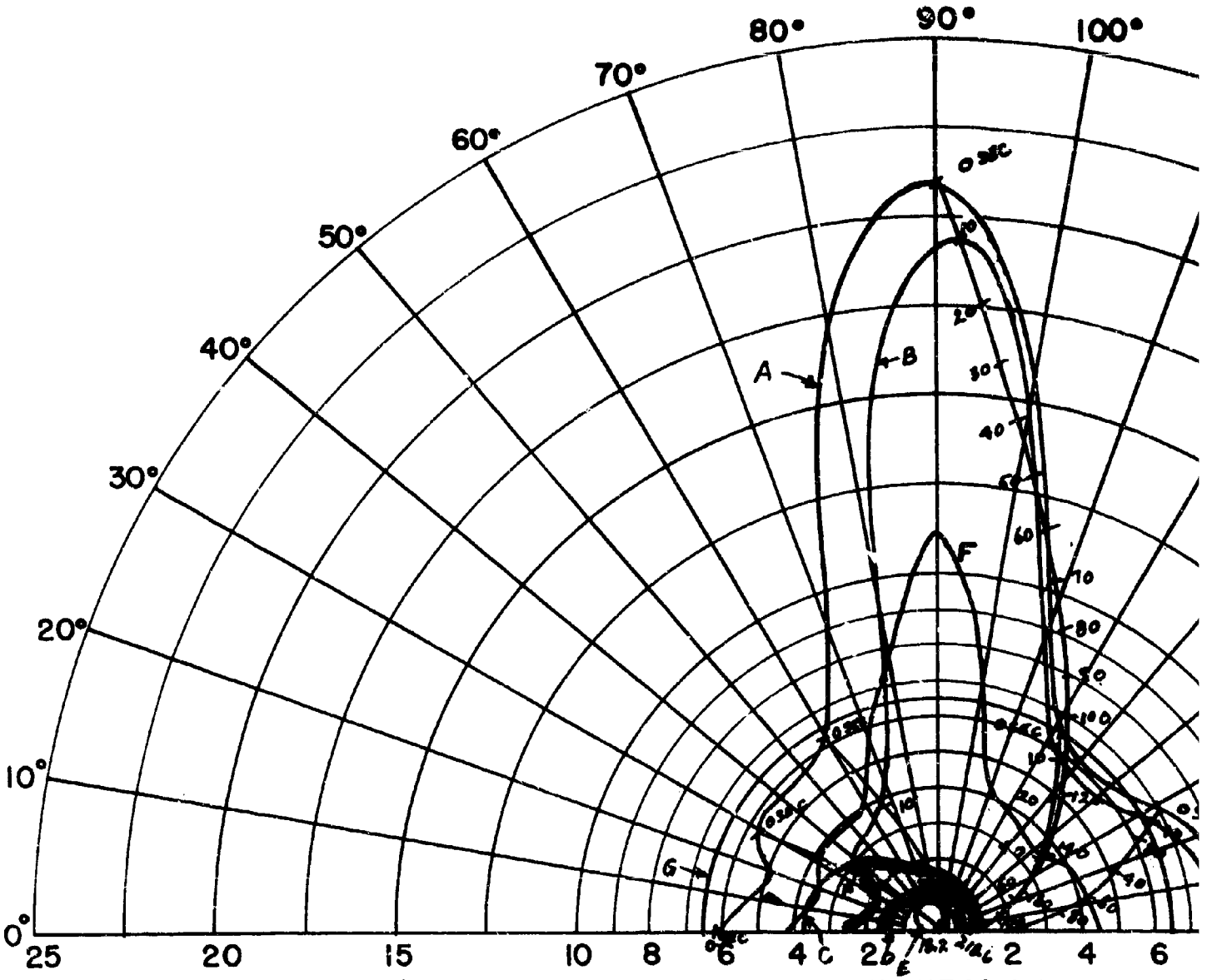

CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 1000 Ft.
Target Speed 1189 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Angle of Attack (α)(°)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds
CONFIDENTIAL

Fig. III-14b



V_F = 1189 FT/SEC (F4H-1)(F8U-3)

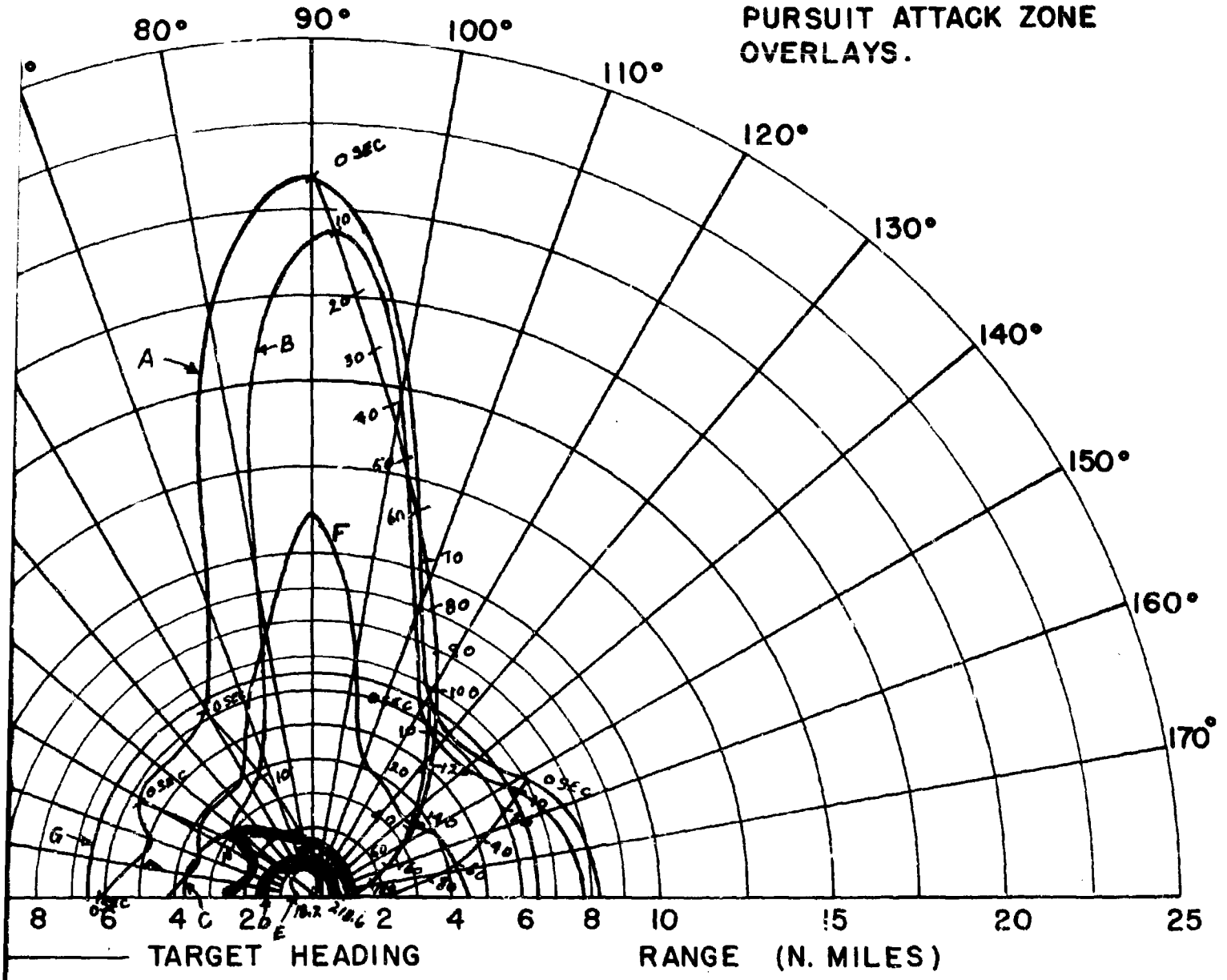
V_T = 951 FT/SEC

ALTITUDE = 1000 FT.

← TARGET HEADING

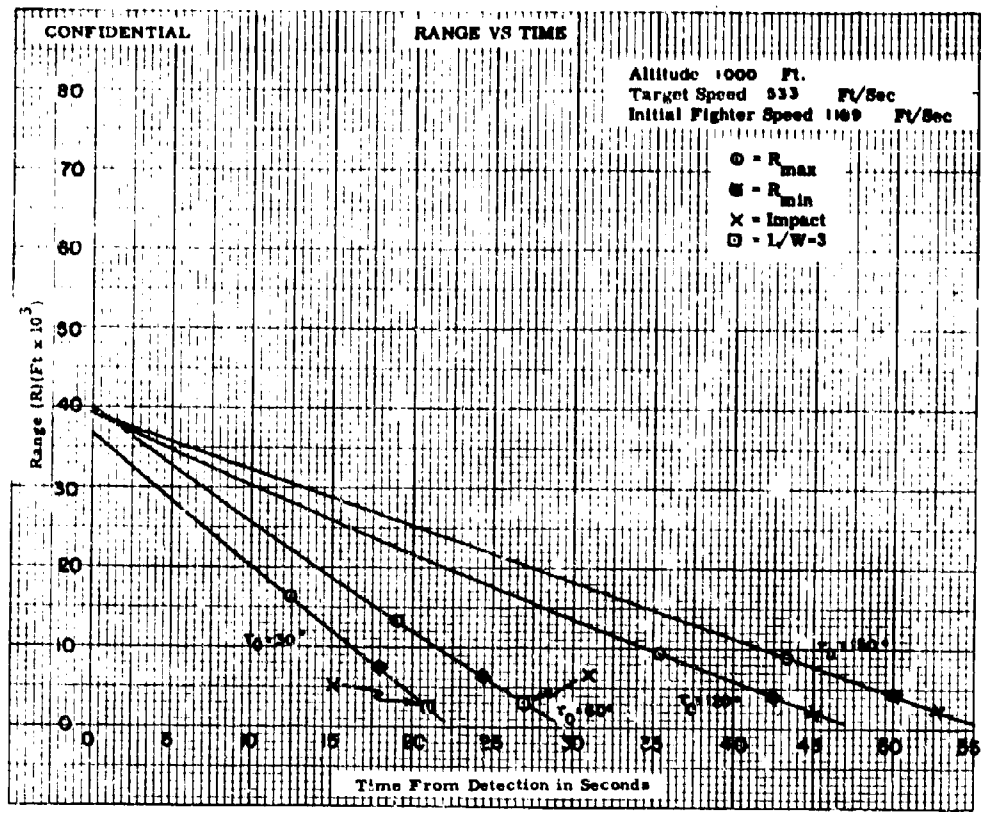
A - 85% DETECTION RANGE
B - LOCK-ON RANGE (10 SEC. LOCK-ON
C - SPARROW III MAX. AERODYNAMIC
D - SPARROW III MIN. AERODYNAMIC
E - CONSTANT LOAD FACTOR LOCUS
F - 90% SPARROW III SEEKER LOCK-
G - 6.5 N.M. INTERLOCK

FIG. IV - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS.



85% DETECTION RANGE
LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
SPARROW III MAX. AERODYNAMIC RANGE
SPARROW III MIN. AERODYNAMIC RANGE
CONSTANT LOAD FACTOR LOCUS (N_z = 3)
90% SPARROW III SEEKER LOCK-ON RANGE
6.5 N.M. INTERLOCK

CONFIDENTIAL


CONFIDENTIAL
RANGE VS TIME
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
⊙ = Rmax
■ = Rmin
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10³)
Time From Detection in Seconds

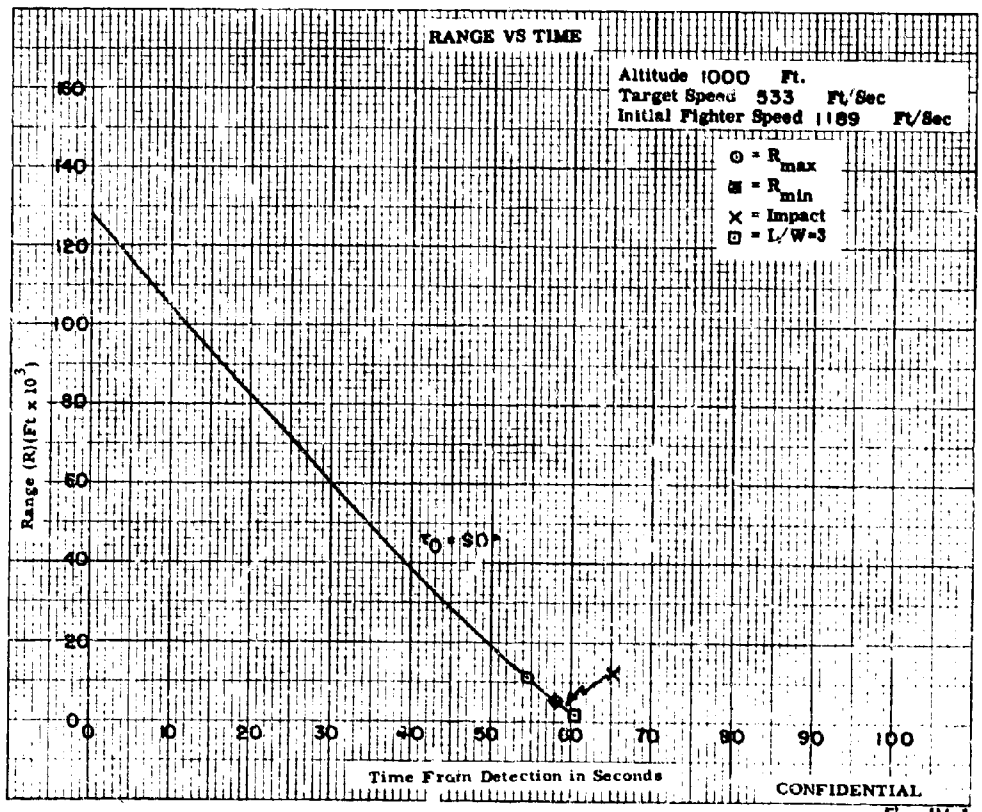
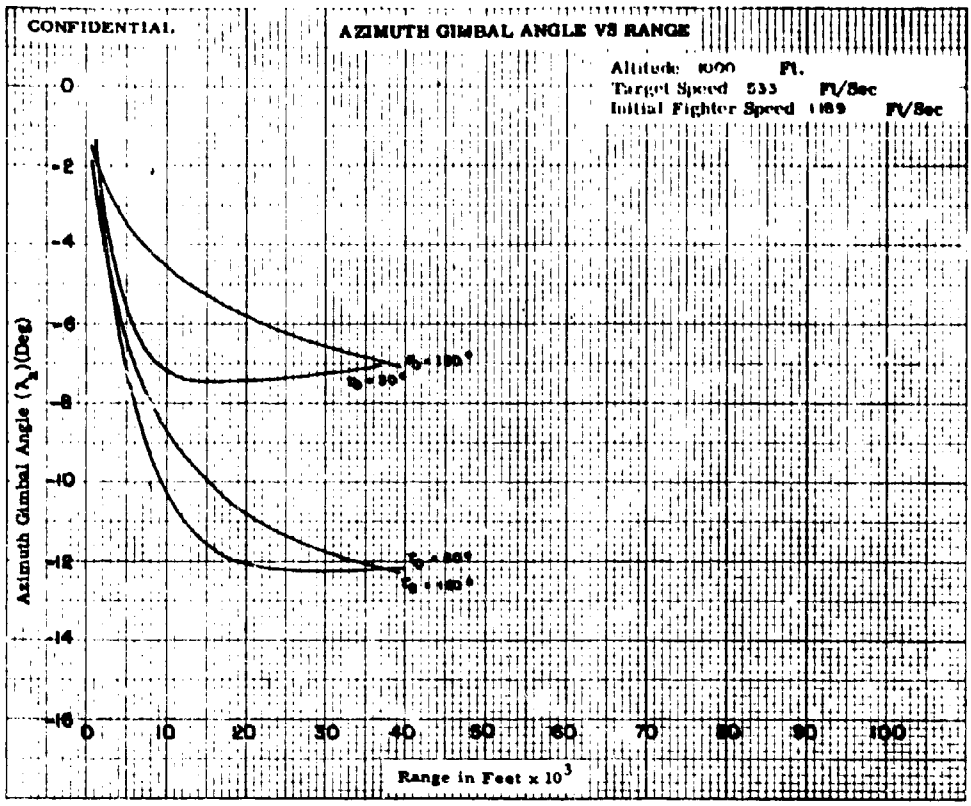

RANGE VS TIME
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
⊙ = Rmax
■ = Rmin
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10³)
Time From Detection in Seconds
CONFIDENTIAL

Fig. IV-1


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azimuth Gimbal Angle (A_g)(Deg)
0
-2
-4
-6
-8
-10
-12
-14
-16
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

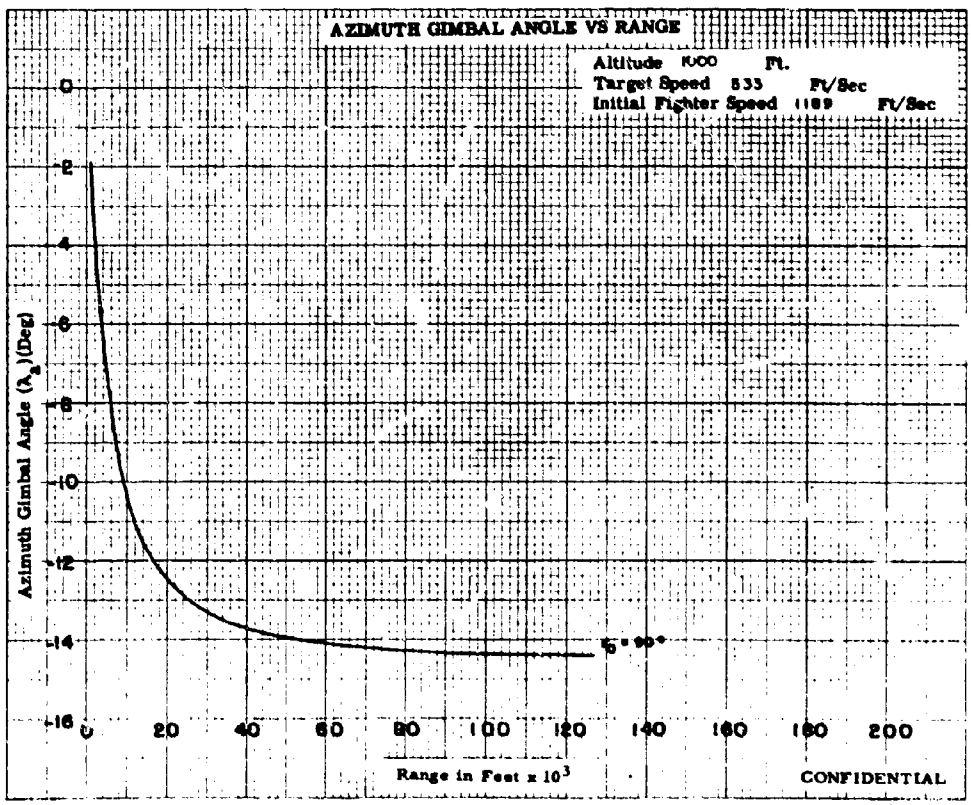
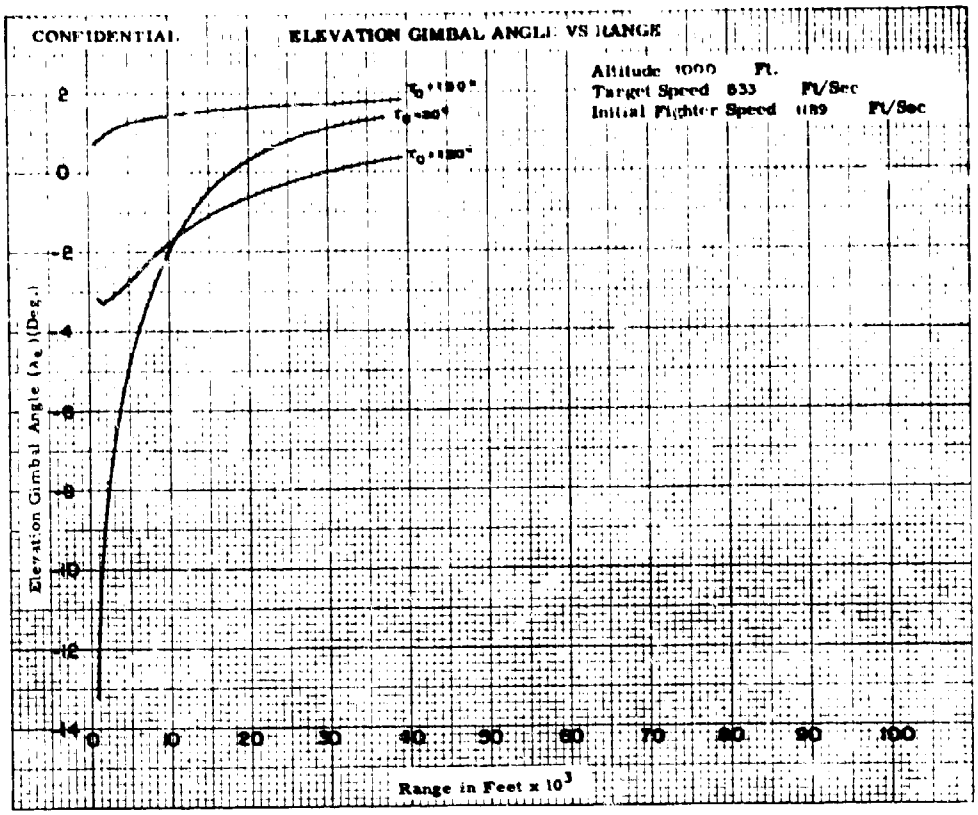

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azimuth Gimbal Angle (A_g)(Deg)
0
-2
-4
-6
-8
-10
-12
-14
-16
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-2


CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 833 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Gimbal Angle (λe) (Deg.)
Range in Feet x 10³

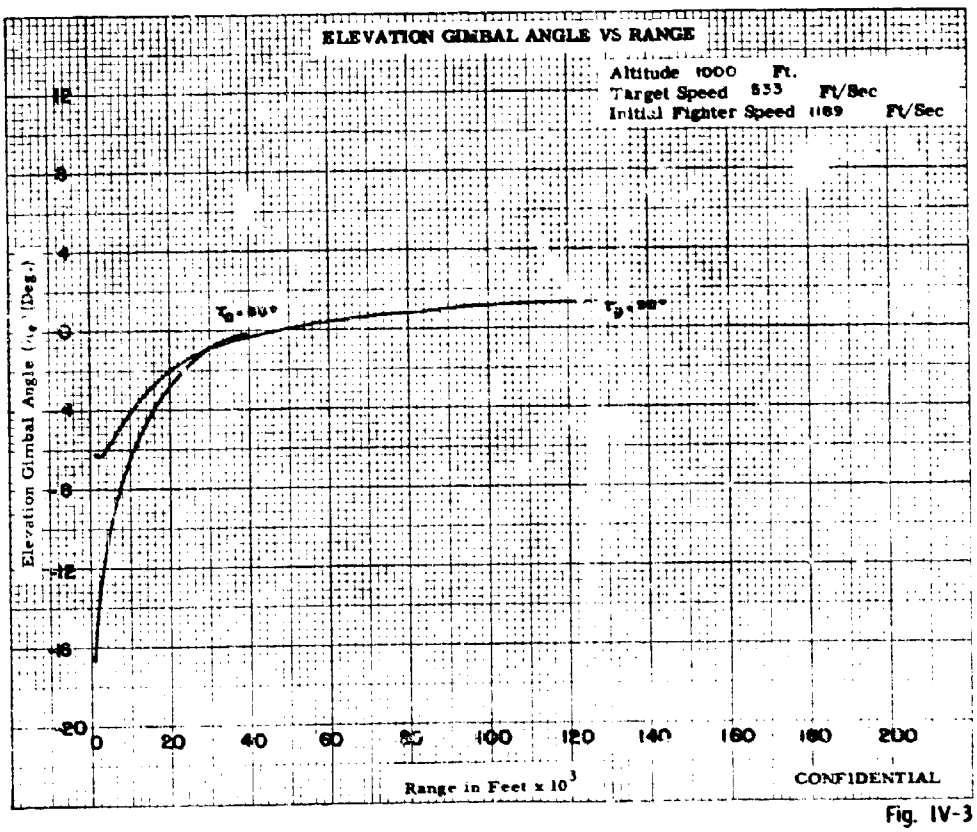
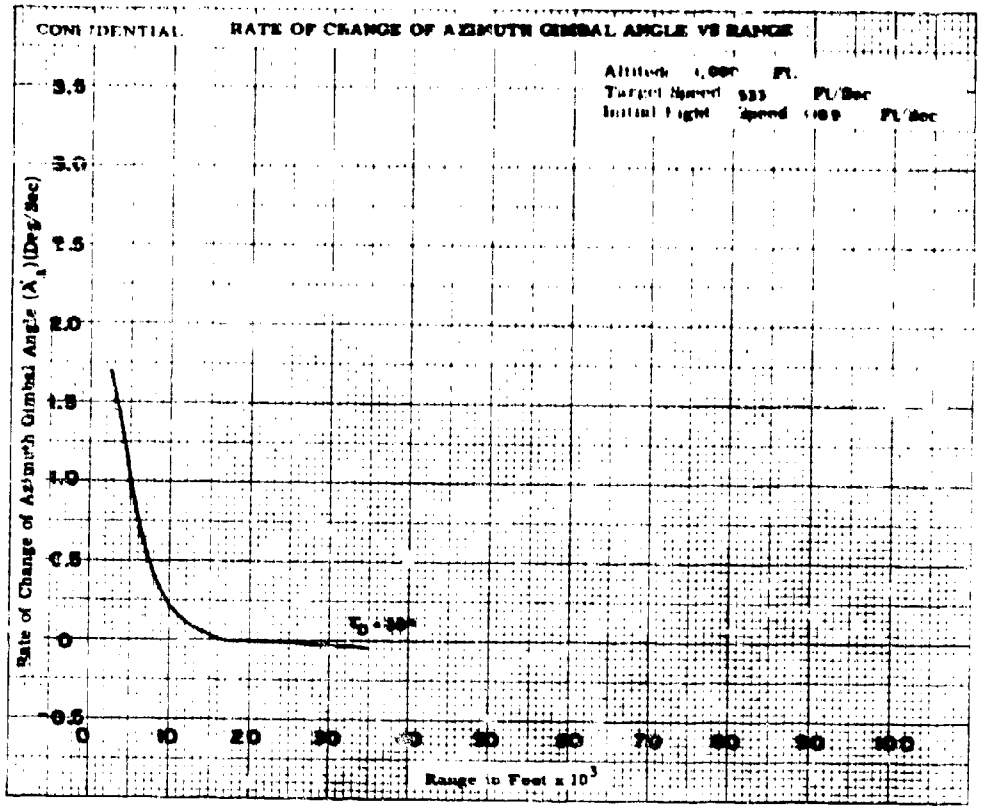

ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 833 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Gimbal Angle (λe) (Deg.)
Range in Feet x 10³
CONFIDENTIAL

Fig. IV-3


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 933 Ft/Sec
Initial Fighter Speed 1159 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{A}_g$)(Deg/Sec)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
Σ_D = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

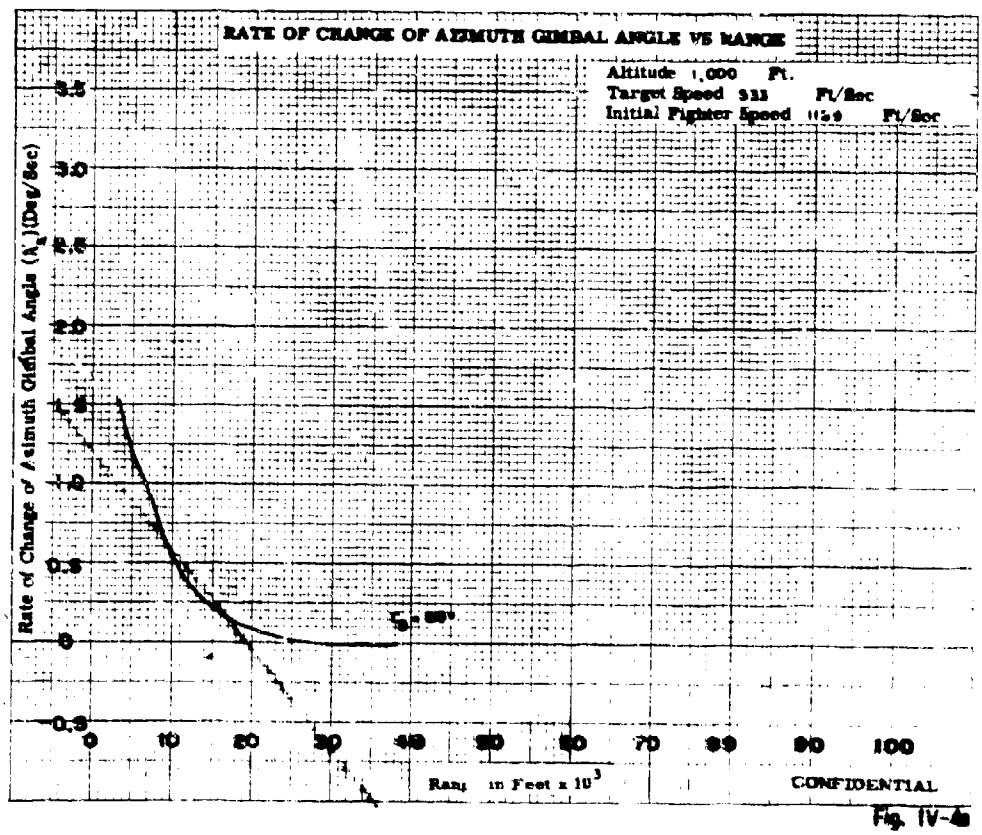
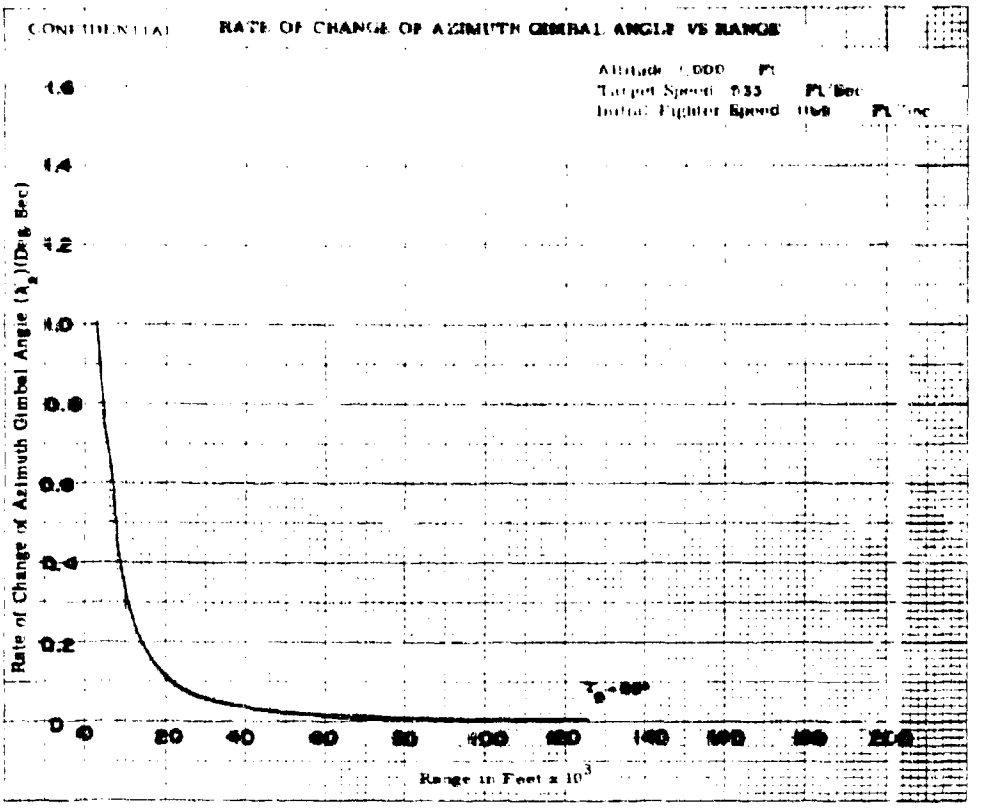
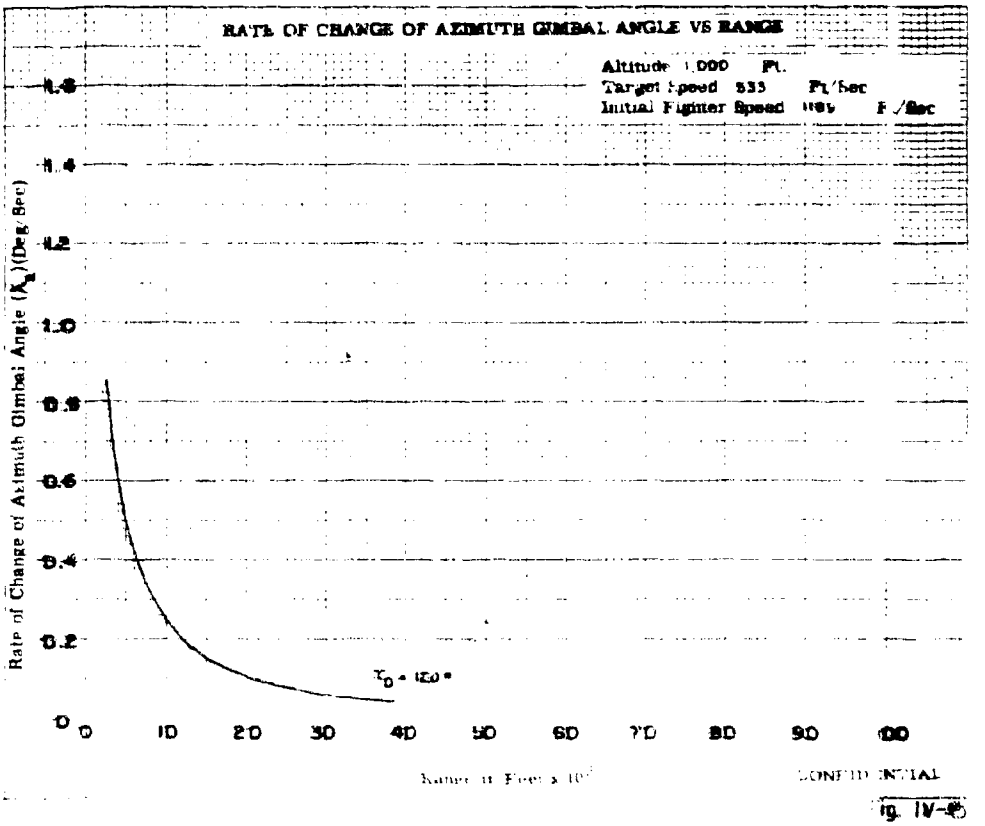

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 933 Ft/Sec
Initial Fighter Speed 1159 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{A}_g$)(Deg/Sec)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
Σ_D = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-4a

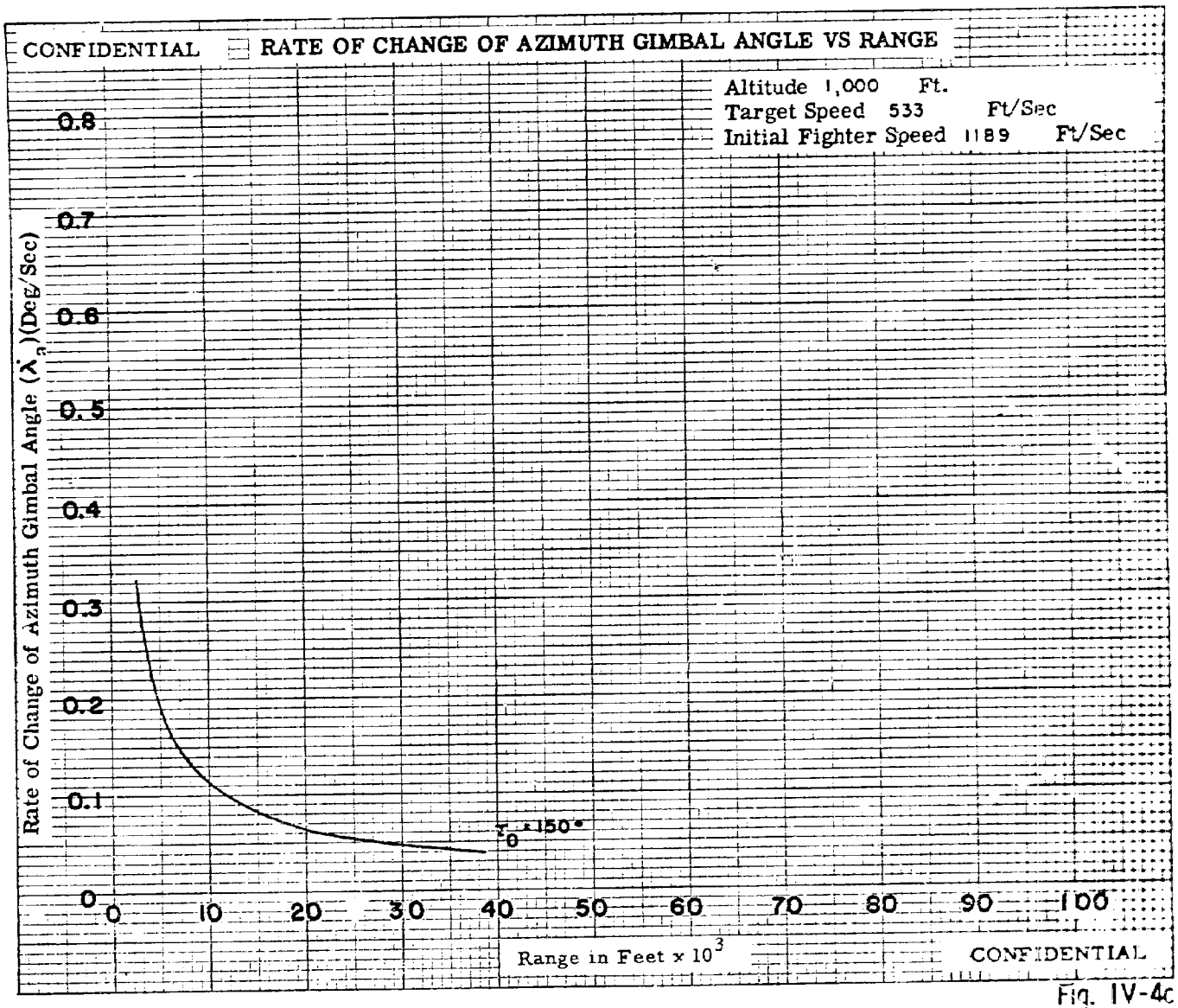
CONFIDENTIAL

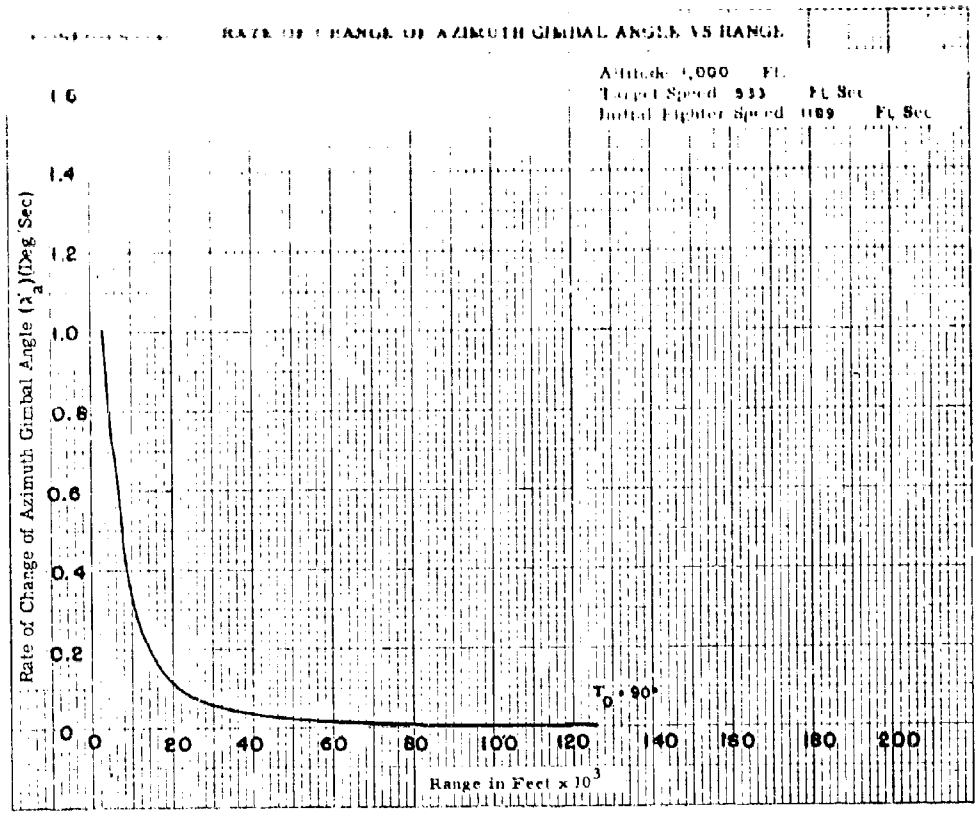




CONFIDENTIAL

Fig. IV-45


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_a$) (Deg/Sec)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
γ_0 = 150°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL
Fig. IV-4c


RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 533 Ft Sec
Initial Fighter Speed 1189 Ft Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_a$)(Deg/Sec)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
T_0 = 90°
0 20 40 60 80 100 120 140 160 180 200
Range in Feet x 10^3

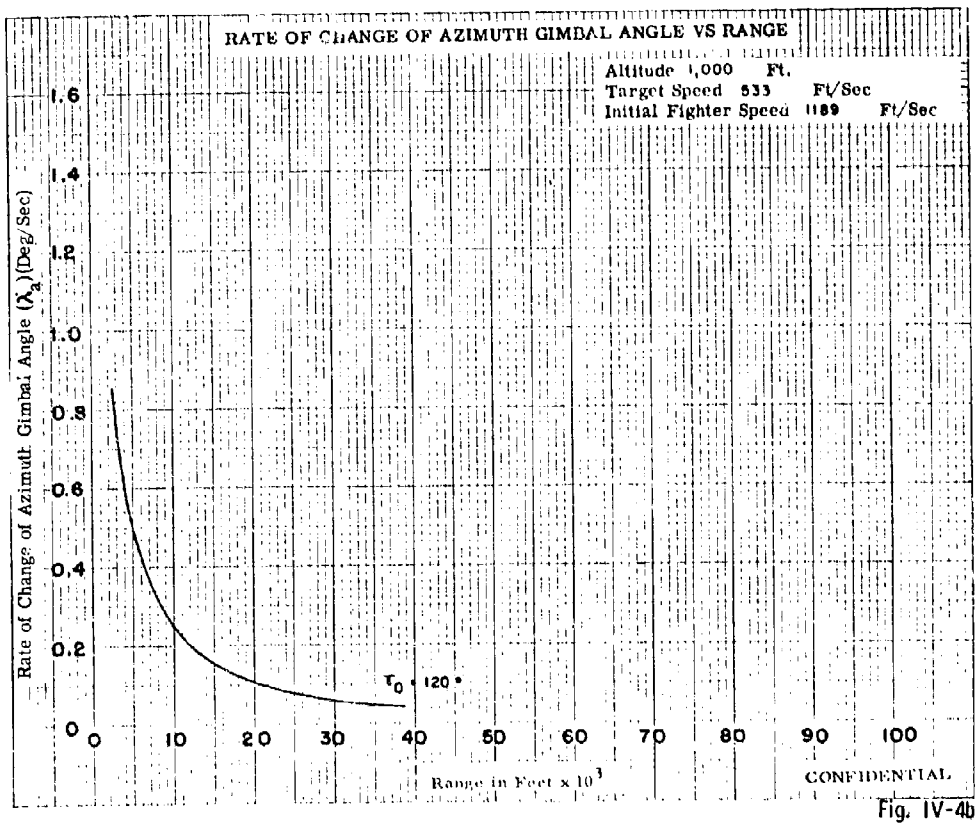

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_a$)(Deg/Sec)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
T_0 = 120°
0 10 20 30 40 50 60 70 80 90 100
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-4b

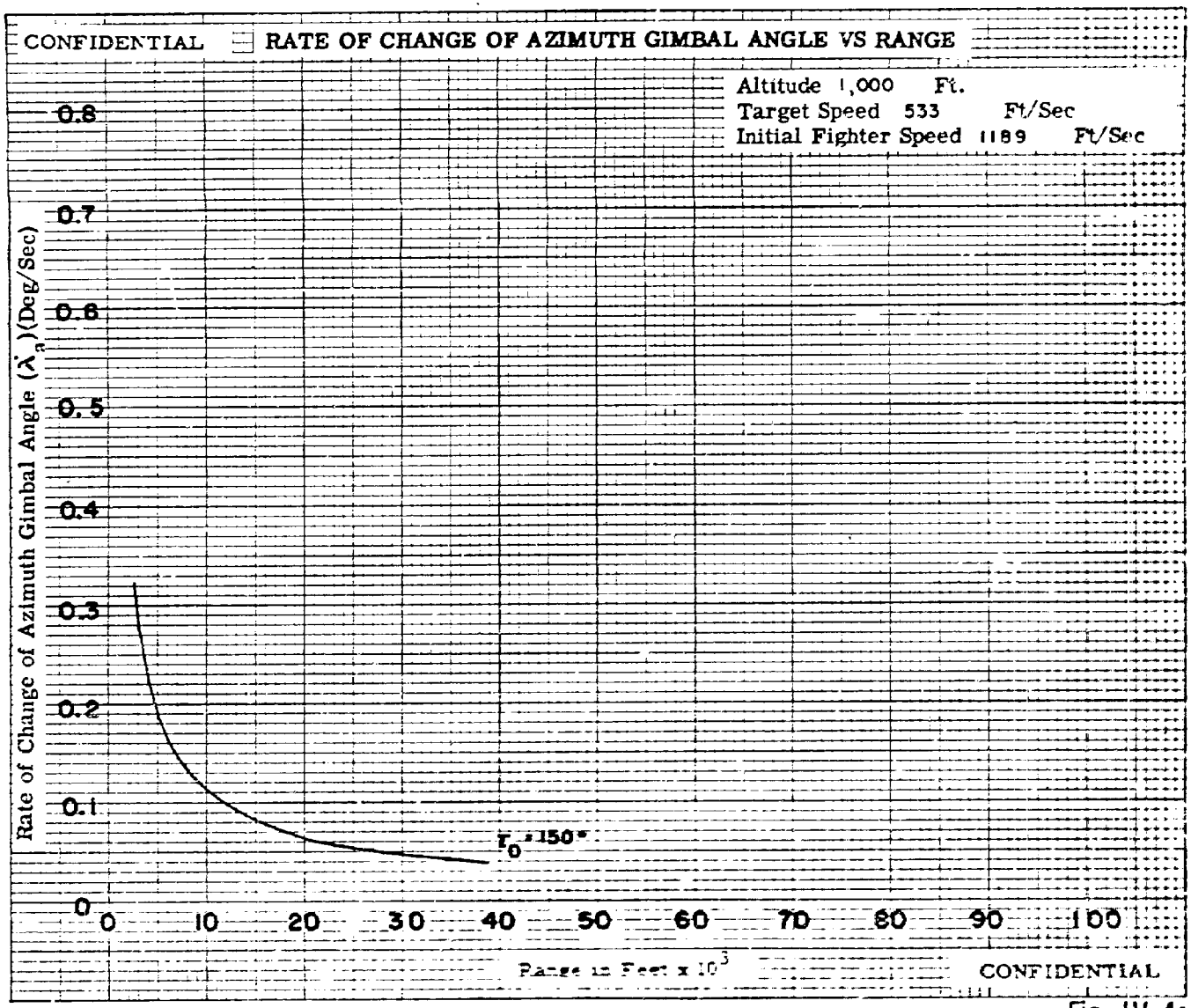
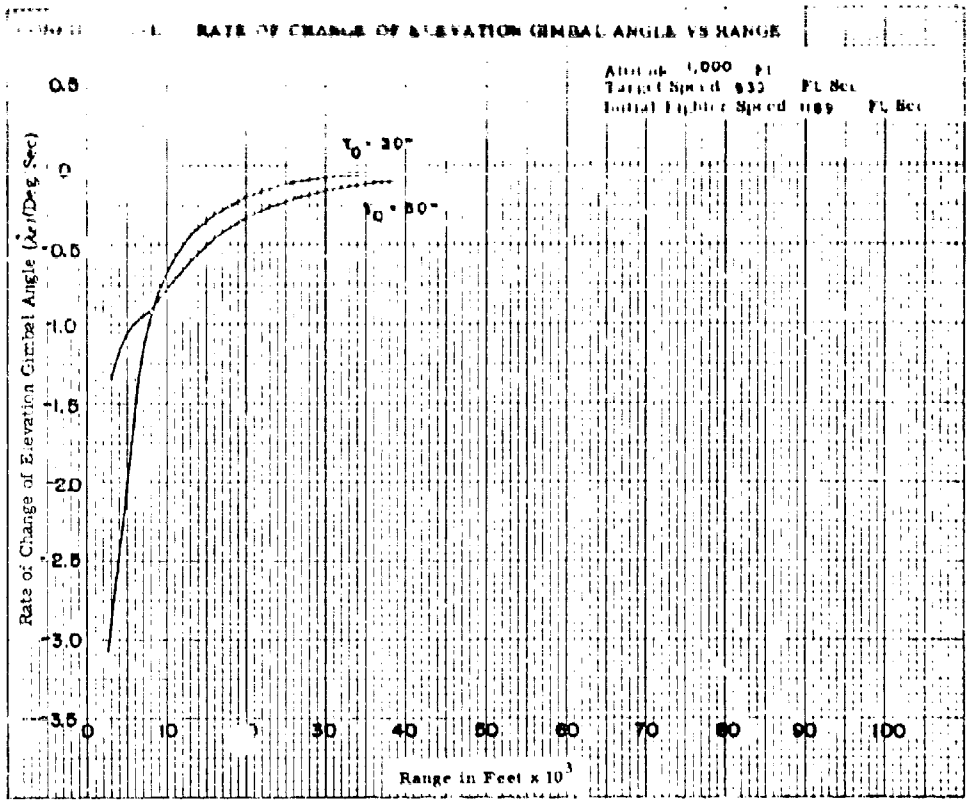

CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_a$)(Deg/Sec)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$\bar{r}_0$ = 150'
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-4c


RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft
Target Speed 933 Ft Sec
Initial Fighter Speed 1189 Ft Sec
$\gamma_0 = 30°$
$\gamma_0 = 90°$
Rate of Change of Elevation Gimbal Angle ($\dot{\lambda}_{el}$)(Deg/Sec)
0.5
0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

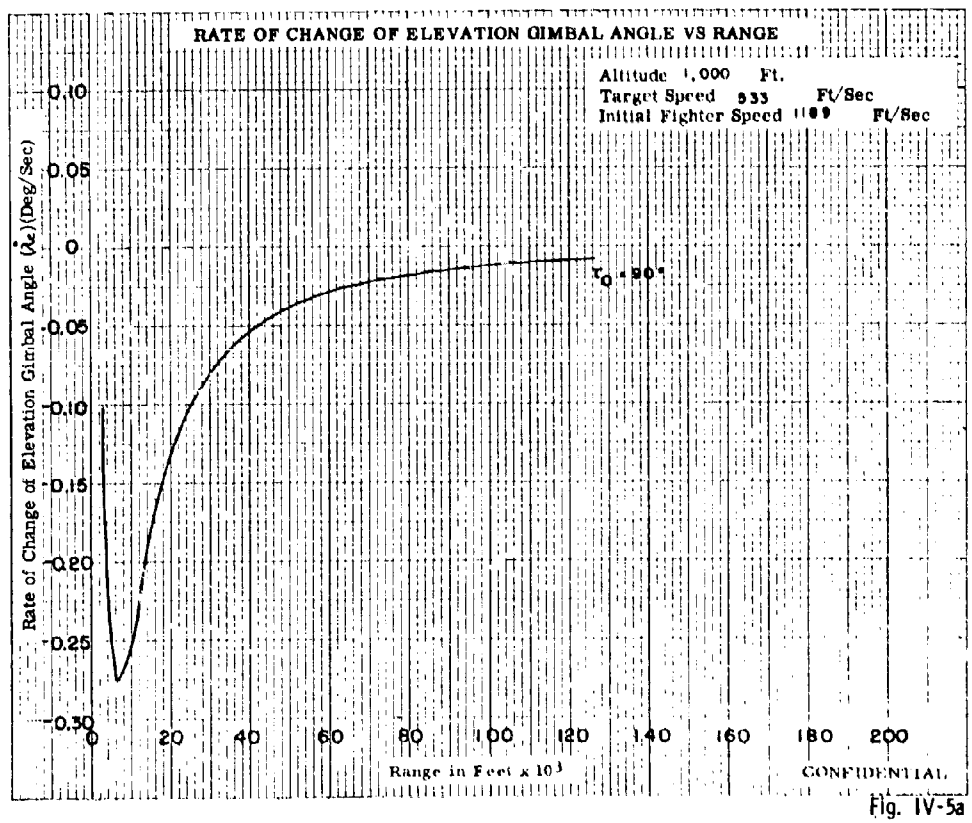
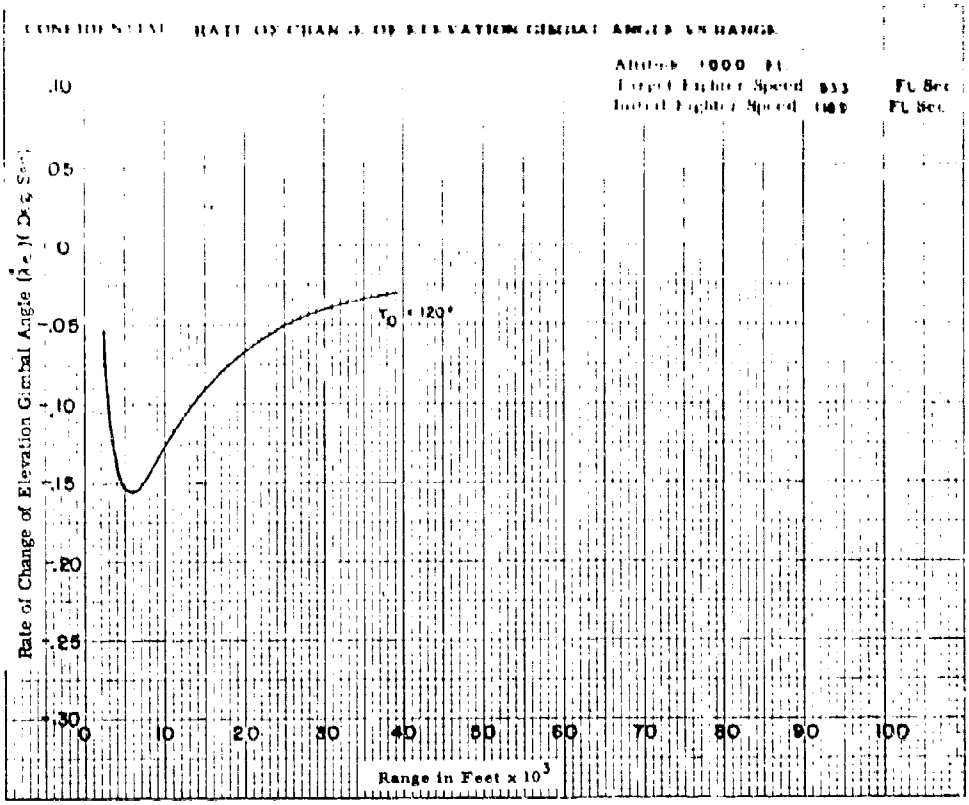

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 933 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
$\gamma_0 = 90°$
Rate of Change of Elevation Gimbal Angle ($\dot{\lambda}_{el}$)(Deg/Sec)
0.10
0.05
0
-0.05
-0.10
-0.15
-0.20
-0.25
-0.30
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-5a


Rate of Change of Elevation Gimbal Angle
Range in Feet x 10^3
γ_0 = 120°

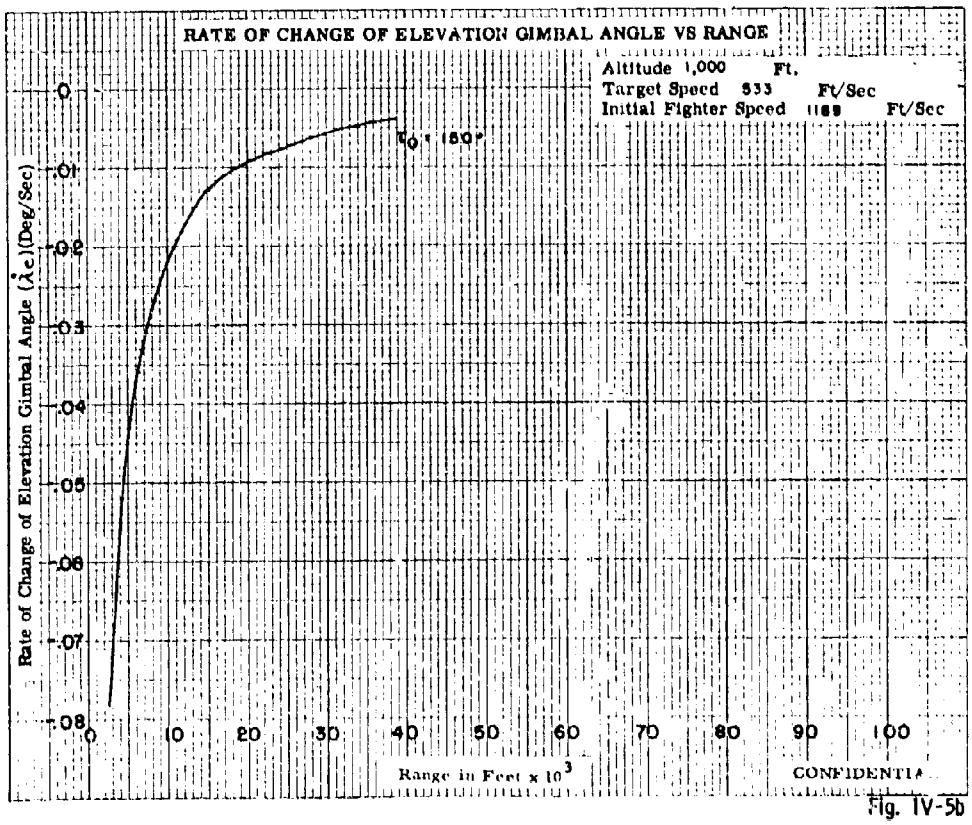

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 1,000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
γ_0 = 180°
Rate of Change of Elevation Gimbal Angle ($\dot{\lambda}_e$)(Deg/Sec)
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-5b

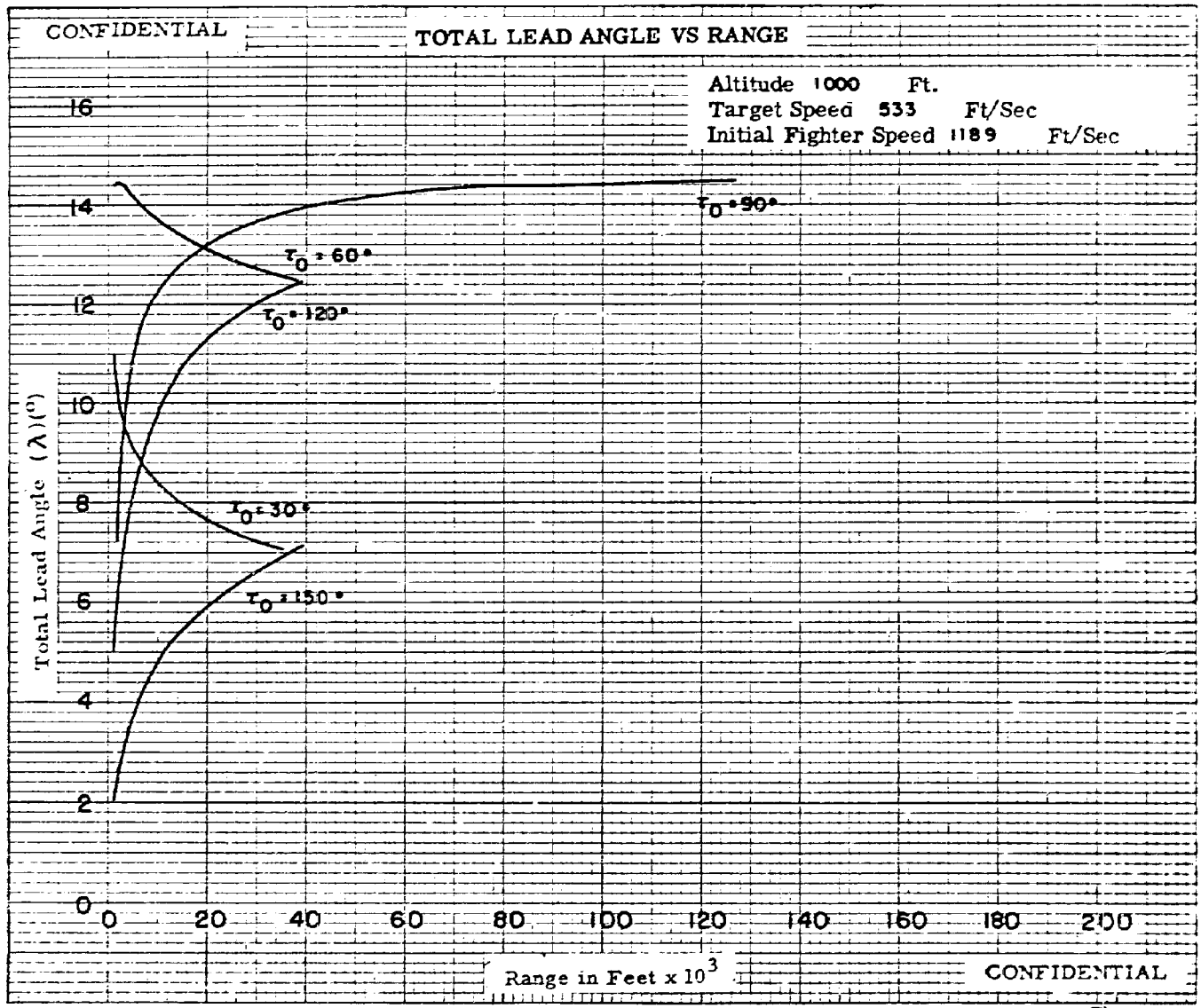

CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
$\tau_0 = 90°$
$\tau_0 = 60°$
$\tau_0 = 120°$
$\tau_0 = 30°$
$\tau_0 = 150°$
Total Lead Angle (λ)(°)
0
2
4
6
8
10
12
14
16
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-6

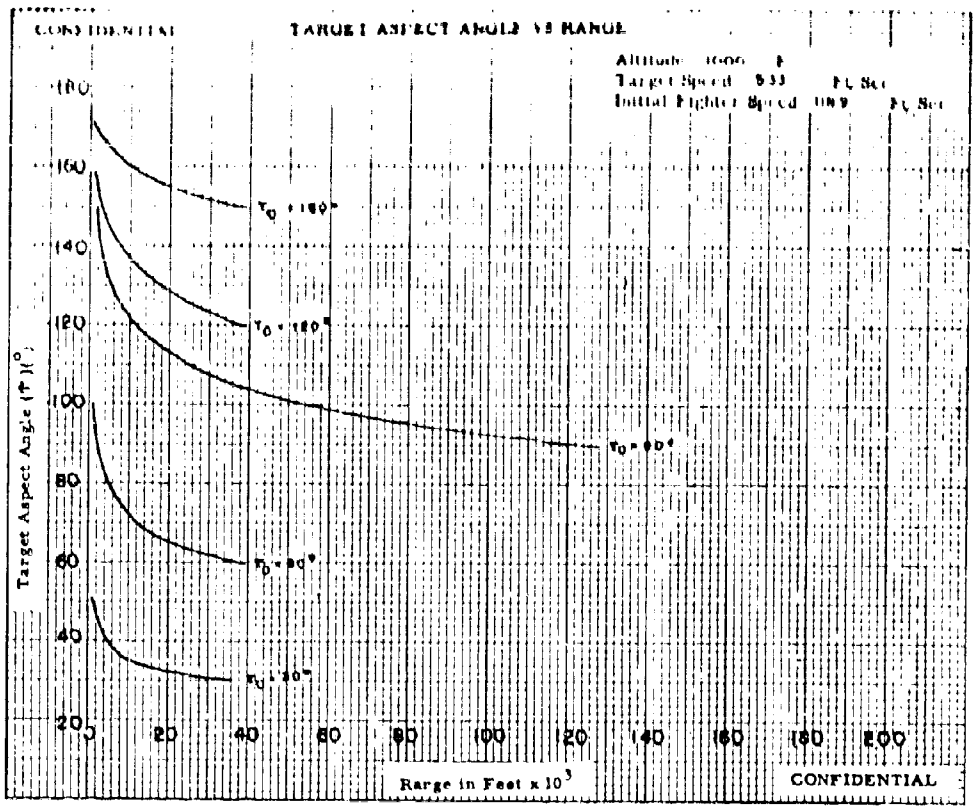


Fig. IV-7

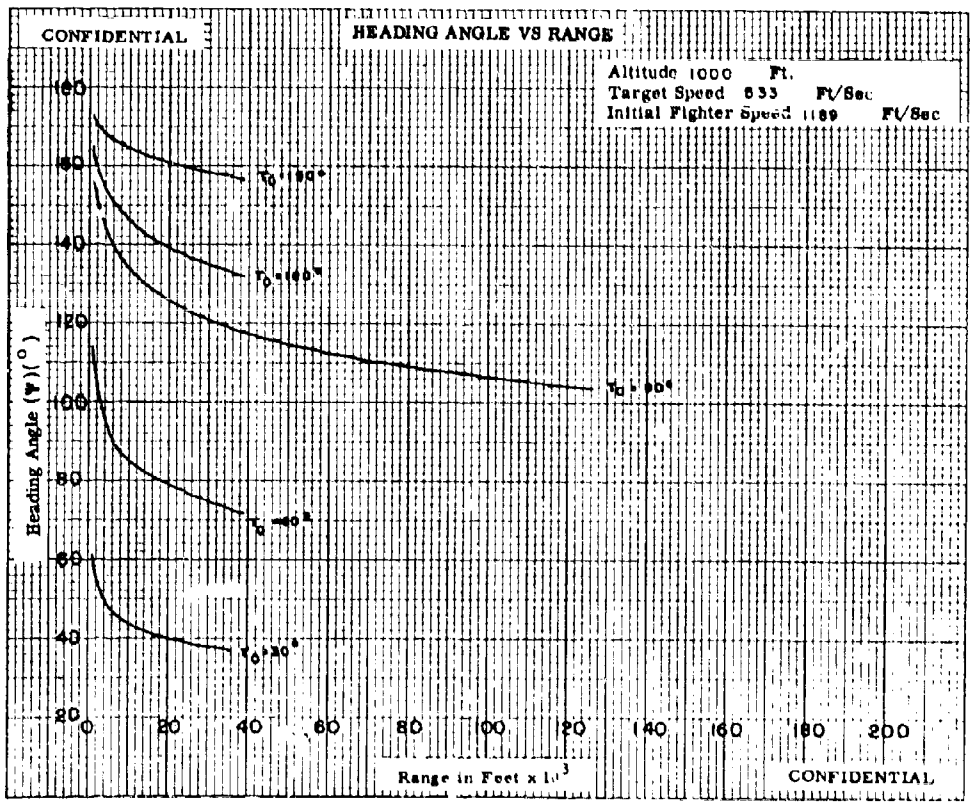
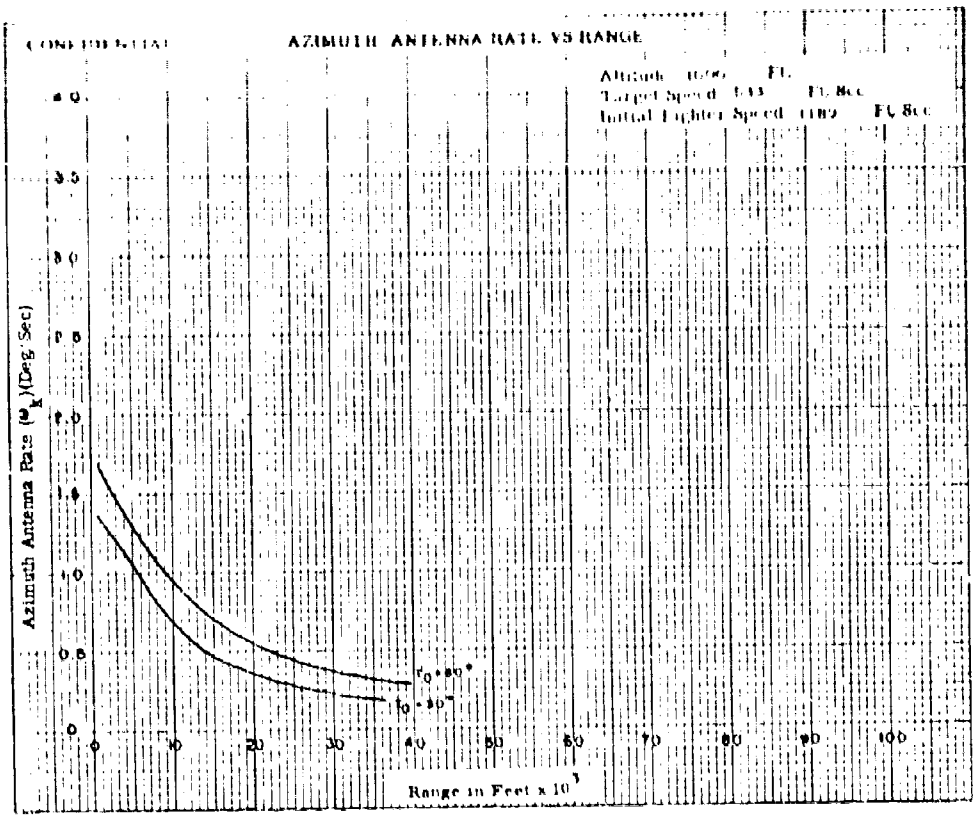


Fig. IV-8


CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 10[illegible] Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azimuth Antenna Rate (ω_k) (Deg/Sec)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
10
20
30
40
50
60
70
80
90
100
$\tau_0 = 90°$
$\tau_0 = 30°$
Range in Feet x 10^3

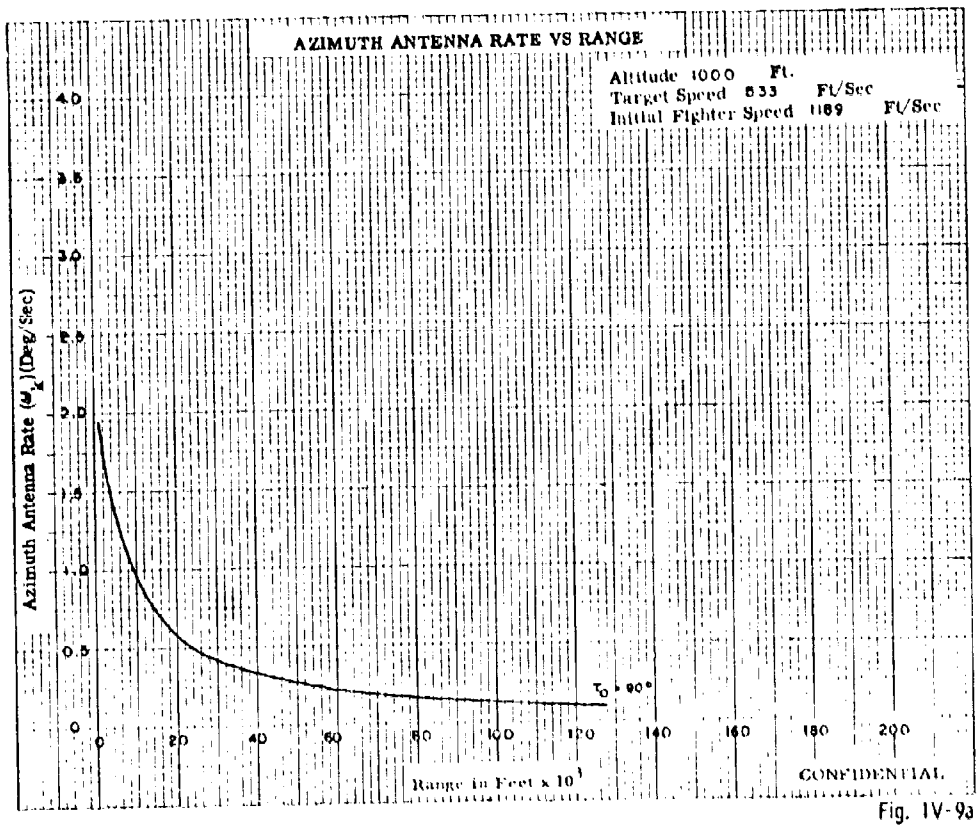

AZIMUTH ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azimuth Antenna Rate (ω_k) (Deg/Sec)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
20
40
60
80
100
120
140
160
180
200
$\tau_0 = 90°$
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-9a

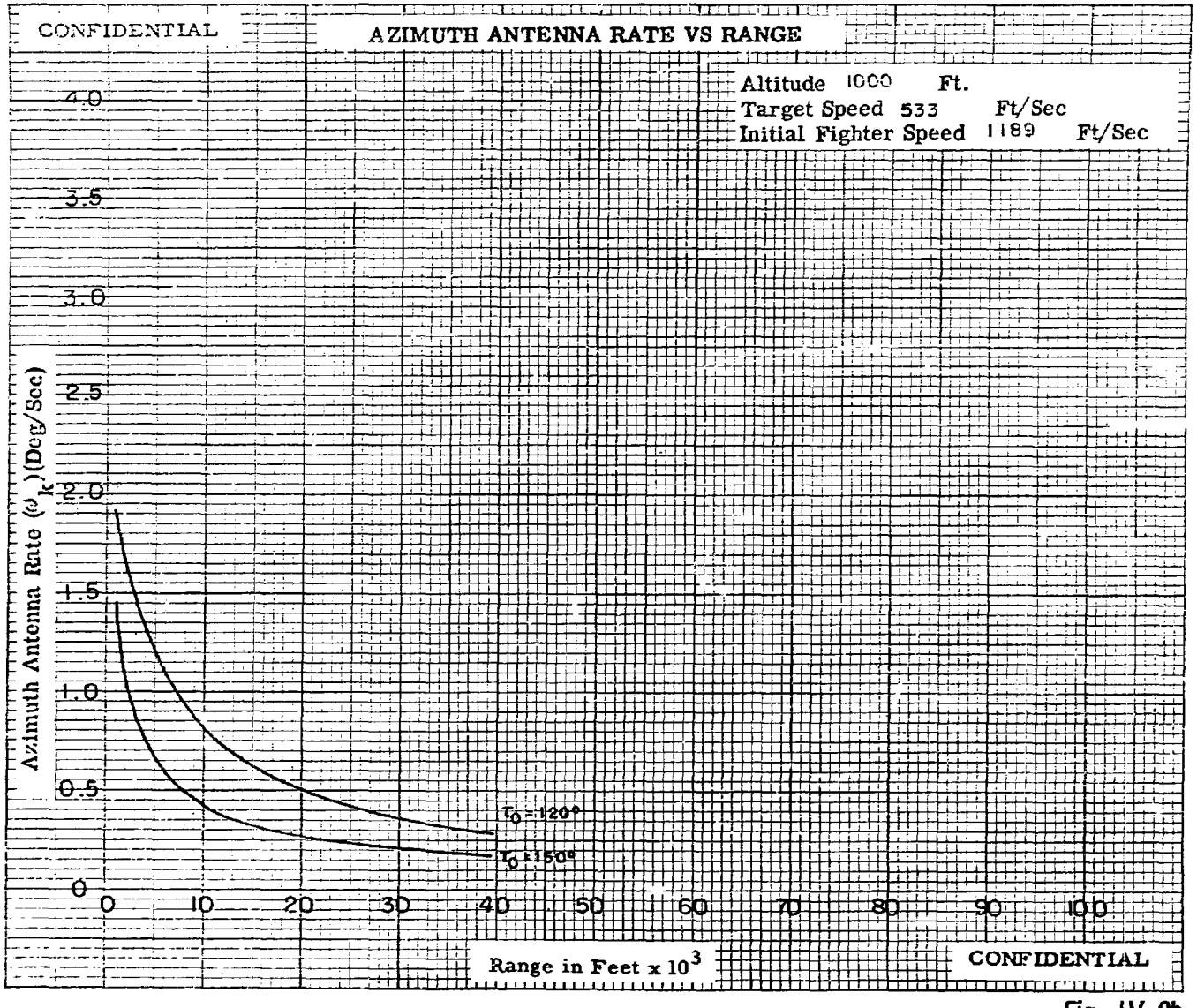
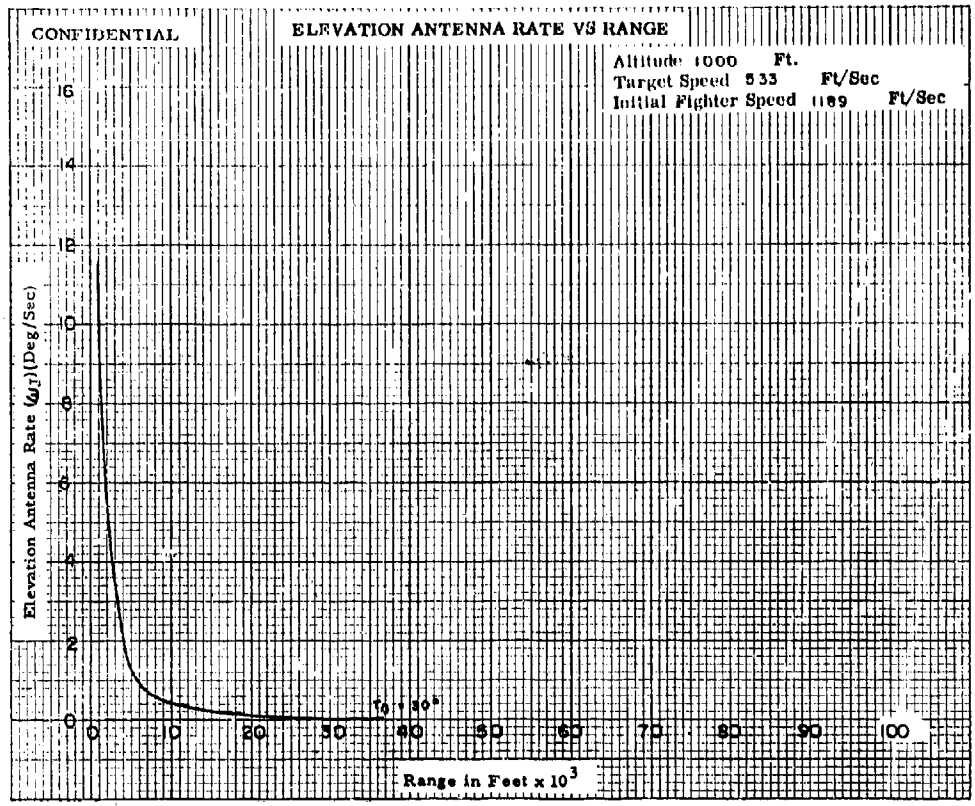

CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Azimuth Antenna Rate (ω_k)(Deg/Sec)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
T_0 = 120°
T_0 = 150°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-9b


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ωT)(Deg/Sec)
Range in Feet x 10^3
0
2
4
6
8
10
12
14
16
10
20
30
40
50
60
70
80
90
100

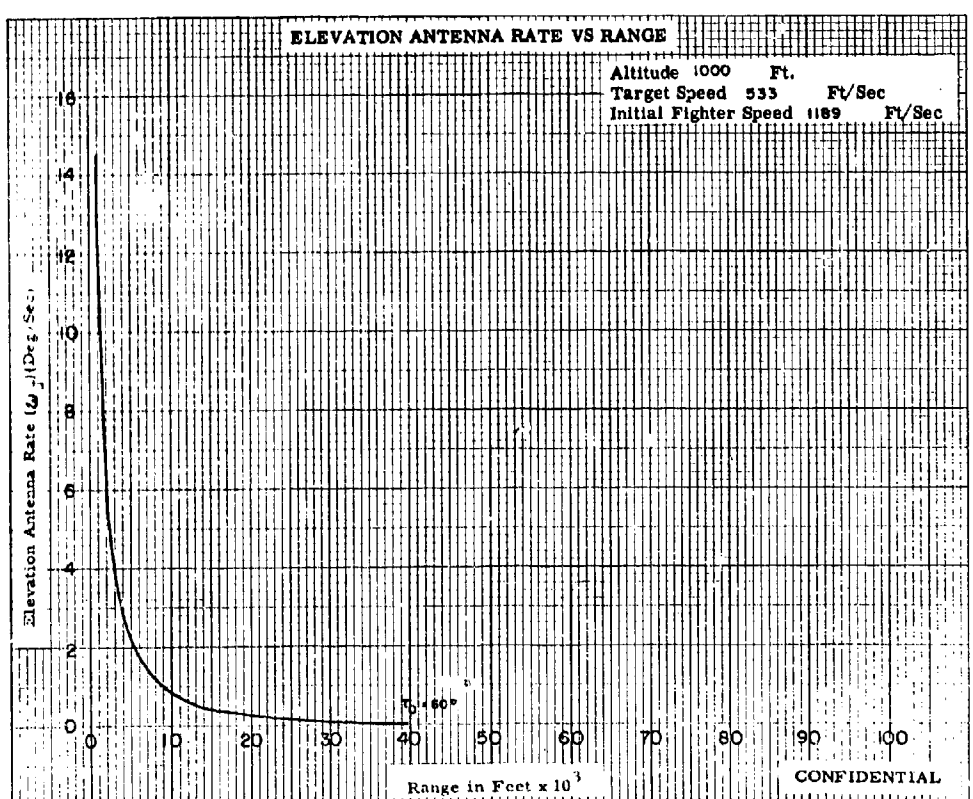
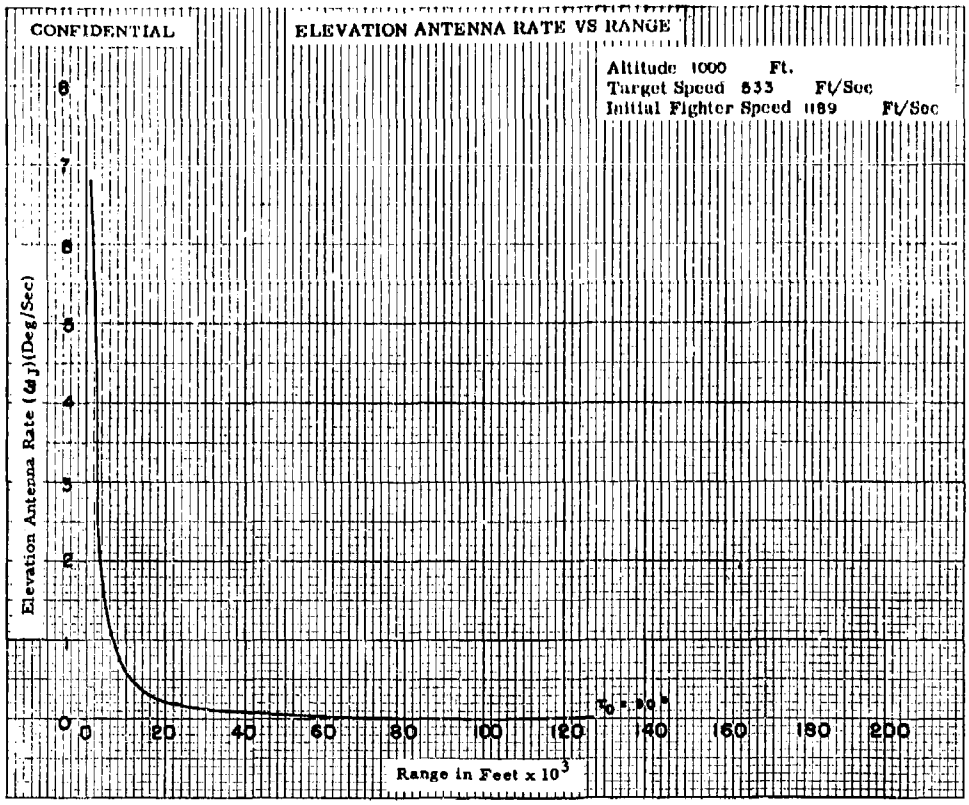

ELEVATION ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ωT)(Deg/Sec)
Range in Feet x 10^3
0
2
4
6
8
10
12
14
16
10
20
30
40
50
60
70
80
90
100
CONFIDENTIAL

Fig. IV-10a


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ω_J)(Deg/Sec)
0
1
2
3
4
5
6
7
8
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

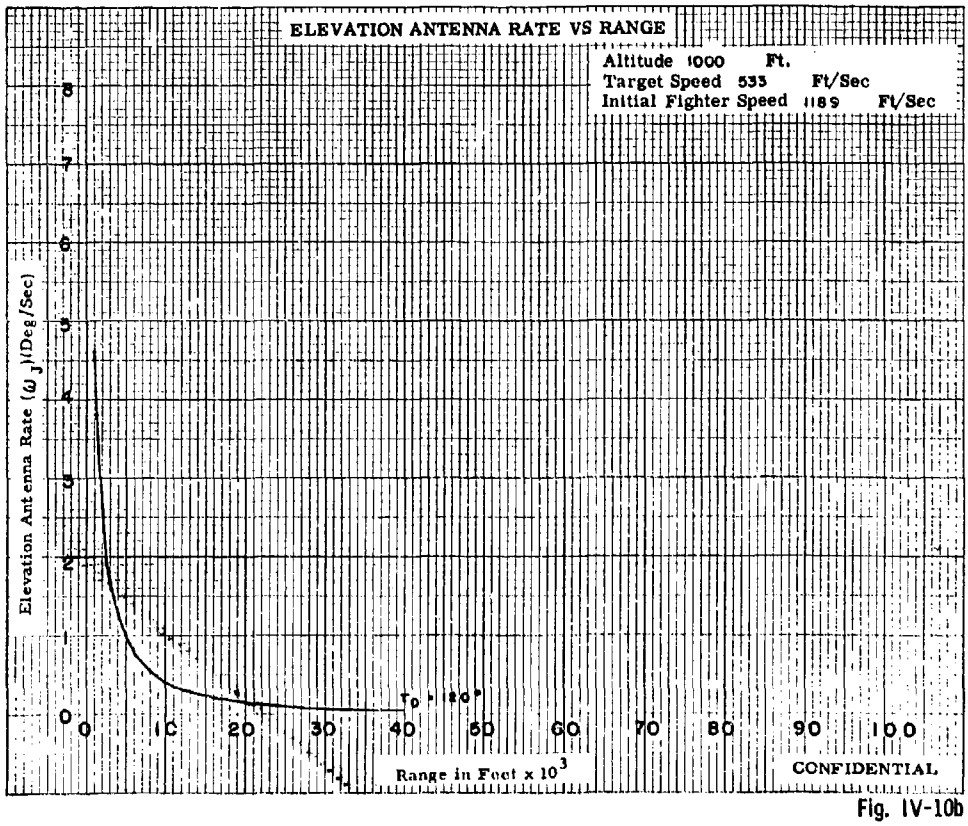

ELEVATION ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ω_J)(Deg/Sec)
0
1
2
3
4
5
6
7
8
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-10b

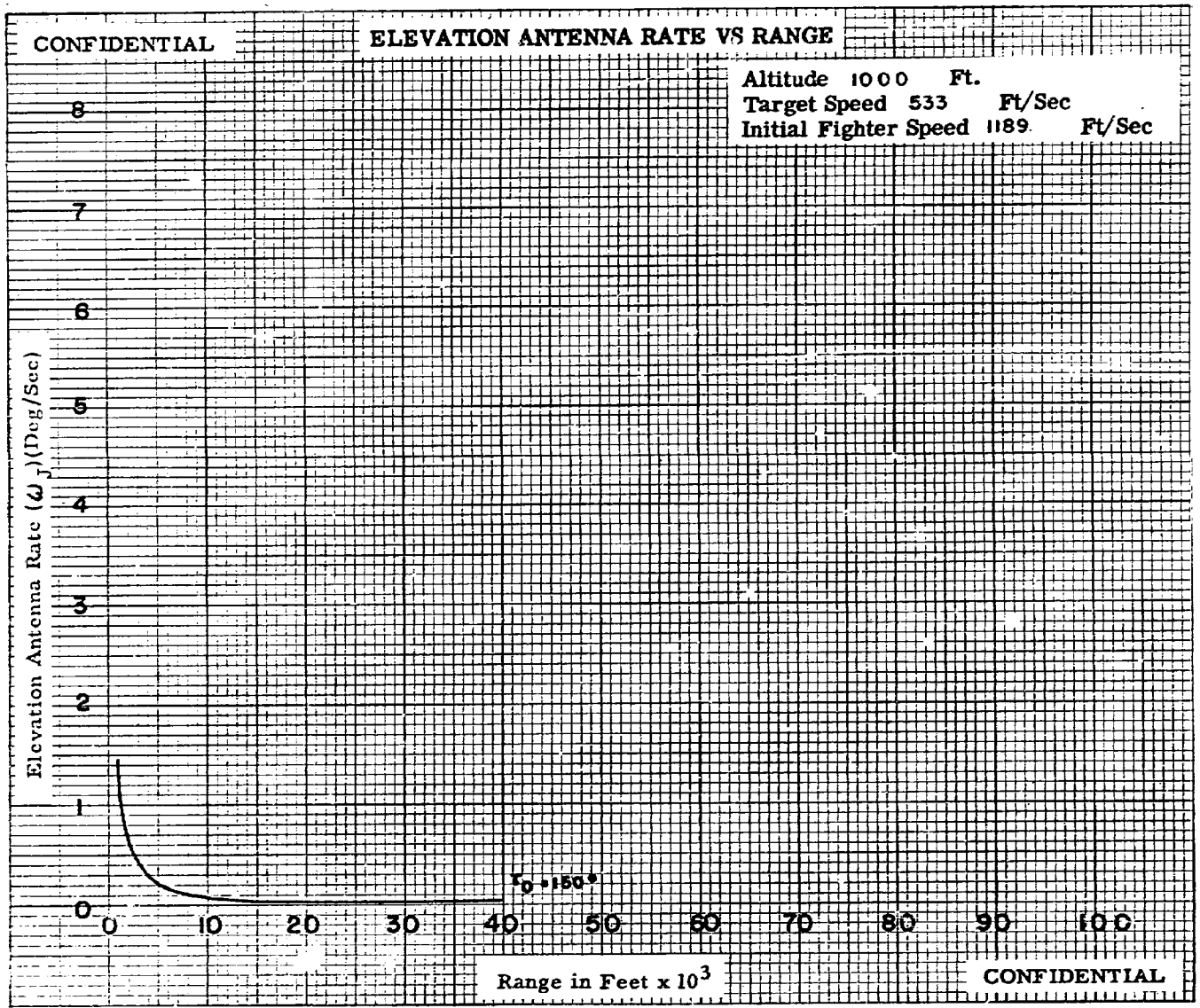
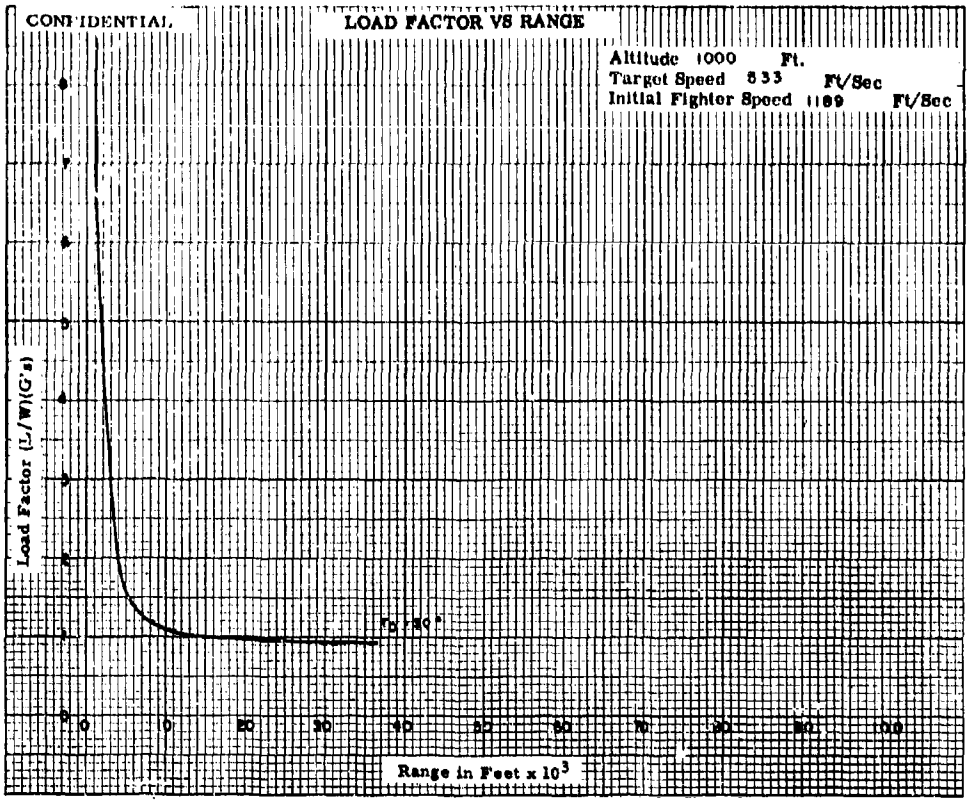

CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Elevation Antenna Rate (ω_T)(Deg/Sec)
0
1
2
3
4
5
6
7
8
τ_0 =150°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-10c


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 1000 Ft.
Target Speed 633 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Load Factor (L/W)(G's)
$\gamma_D = 30°$
Range in Feet x 10^3

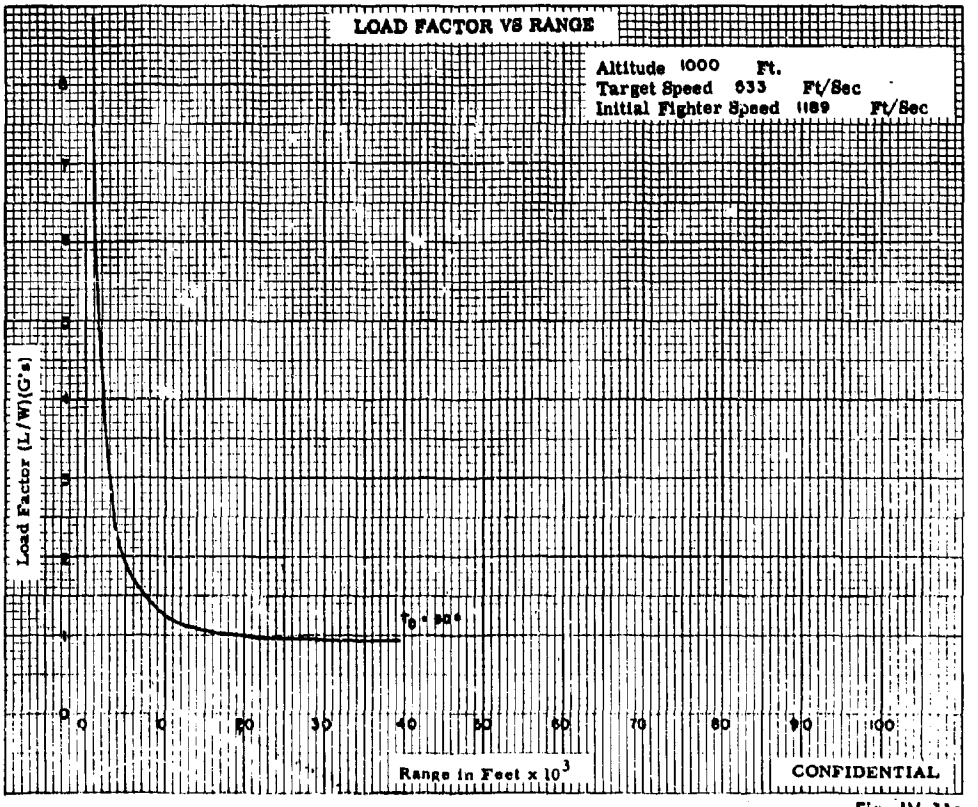
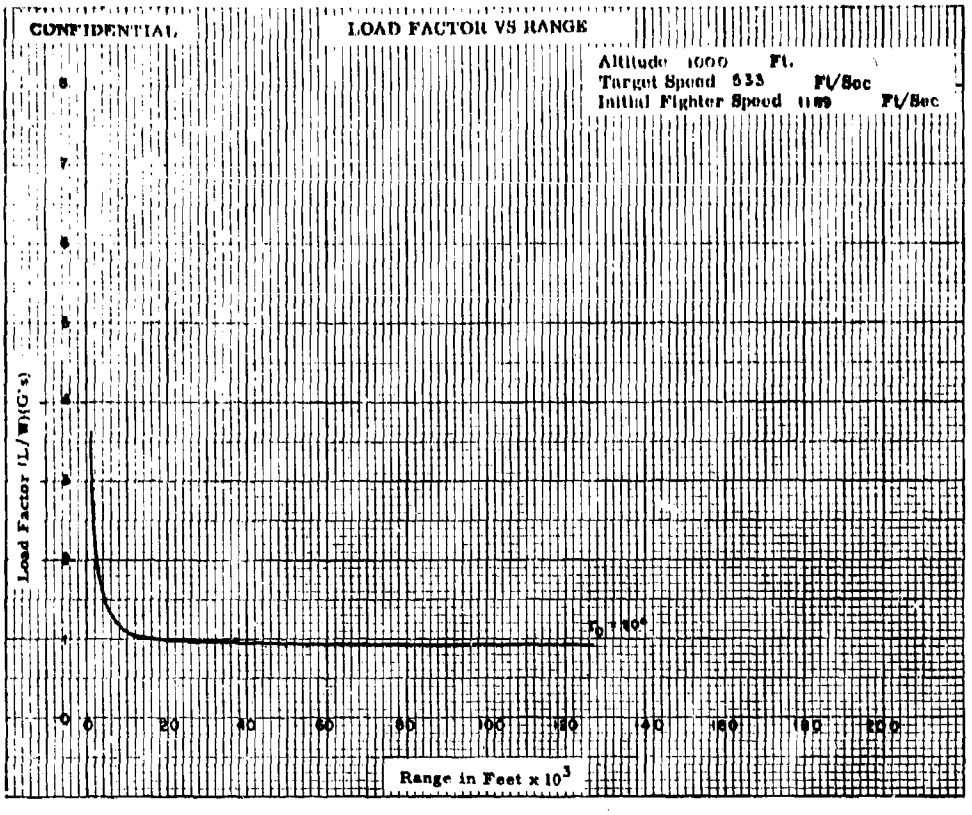

LOAD FACTOR VS RANGE
Altitude 1000 Ft.
Target Speed 633 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Load Factor (L/W)(G's)
$\gamma_D = 30°$
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-11a


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 1000 Ft.
Target Speed 633 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Load Factor (L/W)(G's)
T_D = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

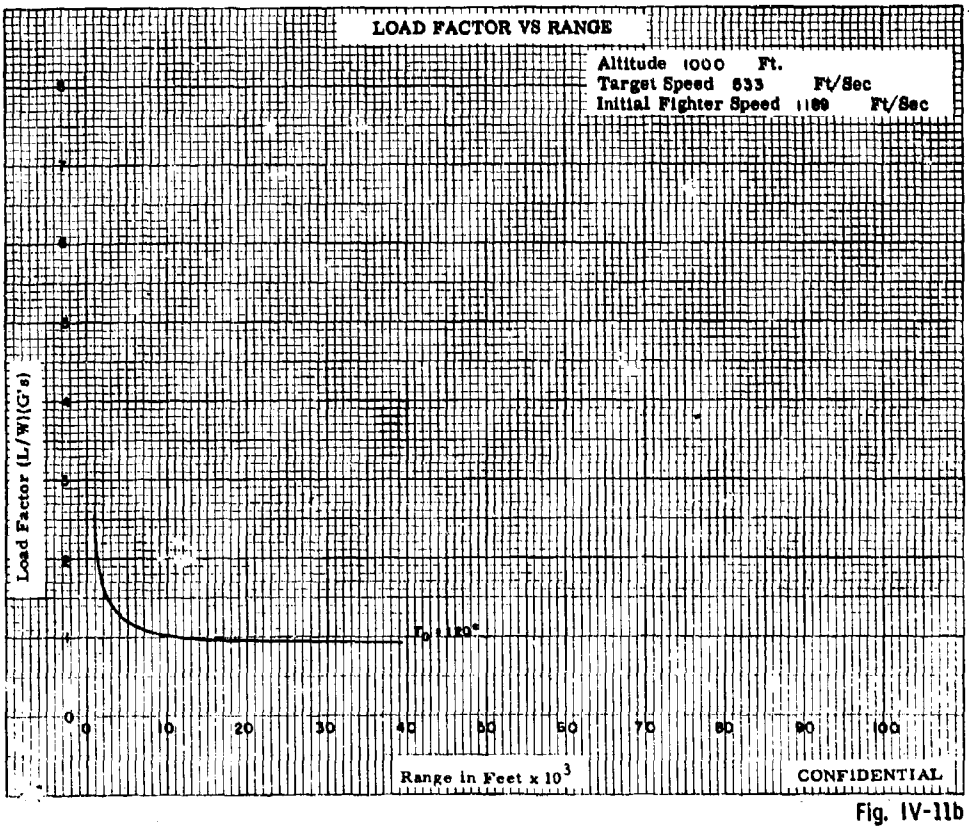

LOAD FACTOR VS RANGE
Altitude 1000 Ft.
Target Speed 633 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Load Factor (L/W)(G's)
T_D = 110°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-11b

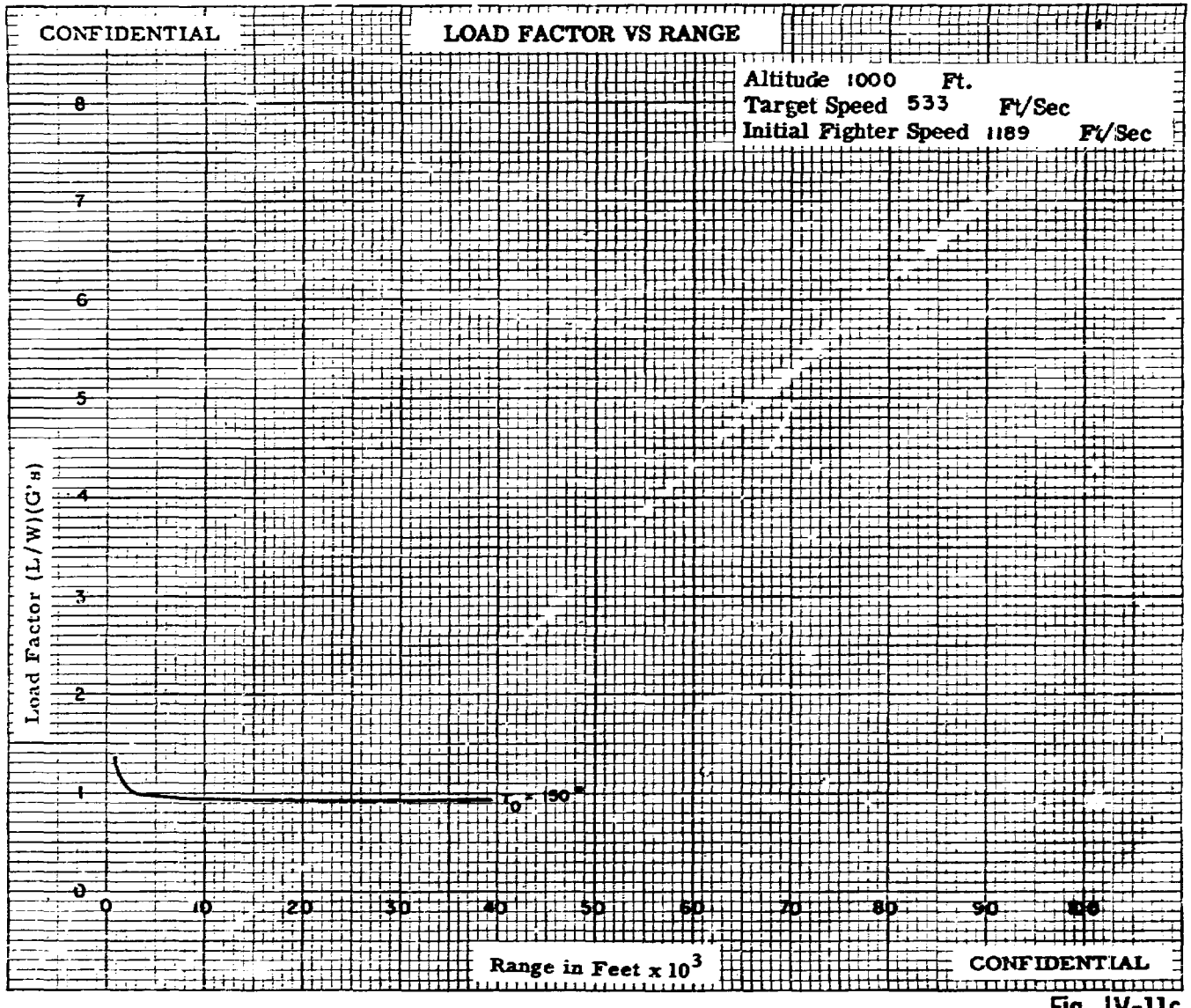
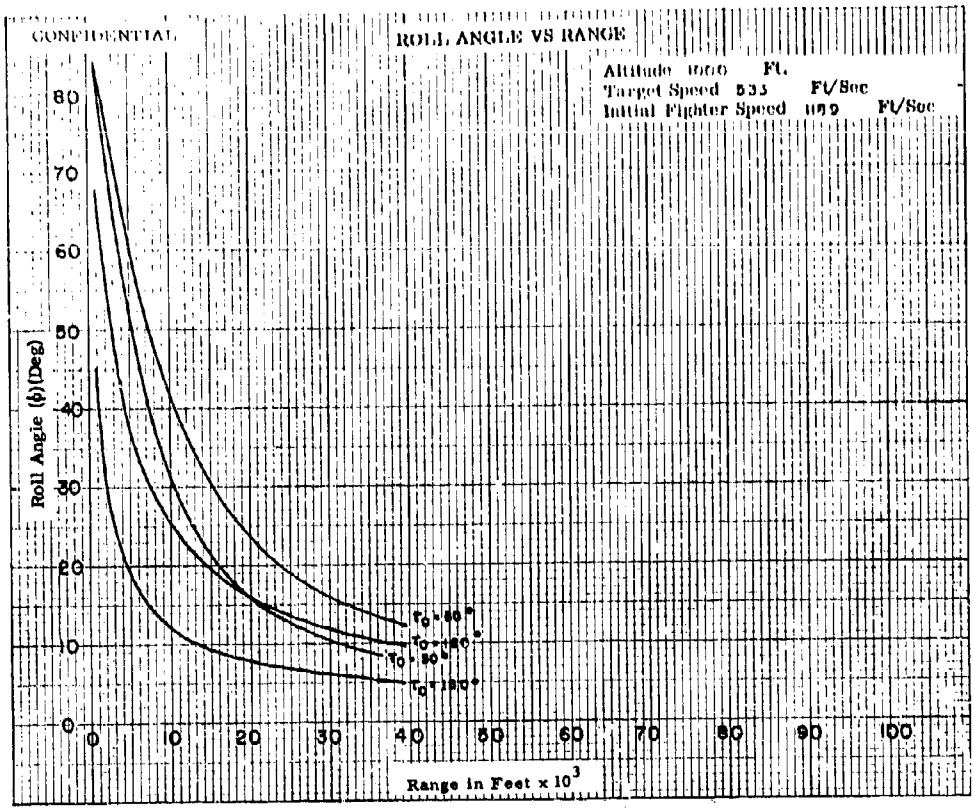

CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Load Factor (L/W)(G's)
8
7
6
5
4
3
2
1
0
t_0 = 150°
0
10
20
30
40
50
60
70
80
90
Range in Feet x 10^3
CONFIDENTIAL

Fig. IV-11c


CONFIDENTIAL
ROLL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Roll Angle (ϕ)(Deg)
Range in Feet x 10^3
T_Q = 60°
T_Q = 120°
T_Q = 90°
T_Q = 180°

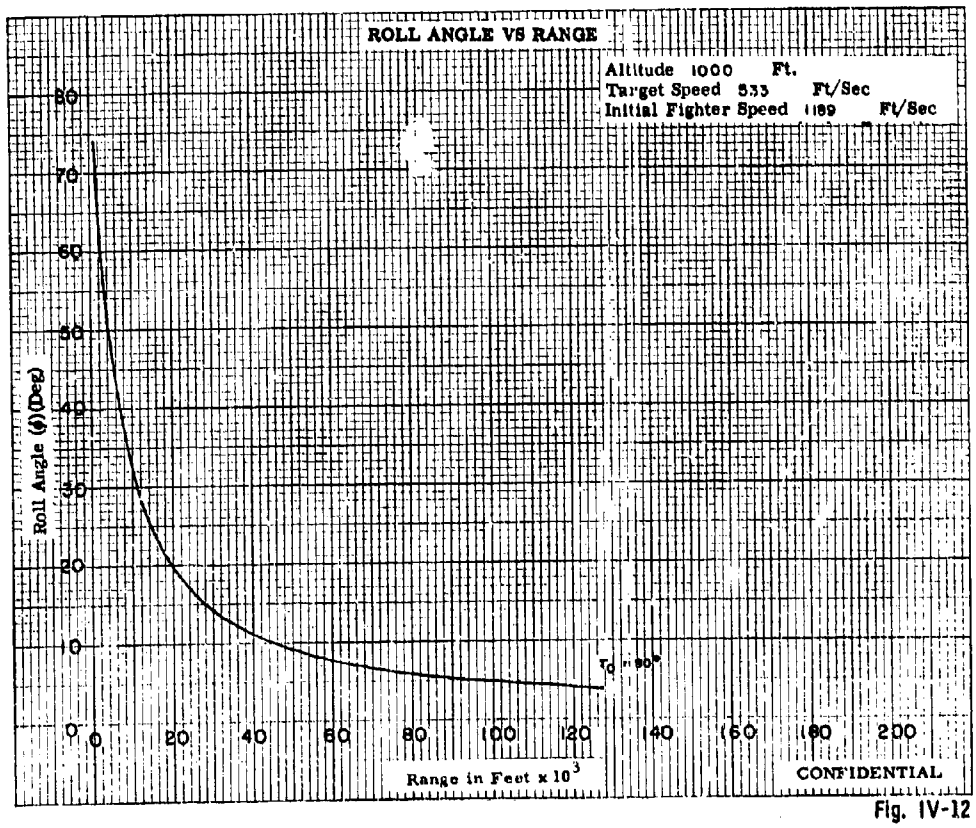

ROLL ANGLE VS RANGE
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Roll Angle (ϕ)(Deg)
Range in Feet x 10^3
T_Q = 90°
CONFIDENTIAL

Fig. IV-12

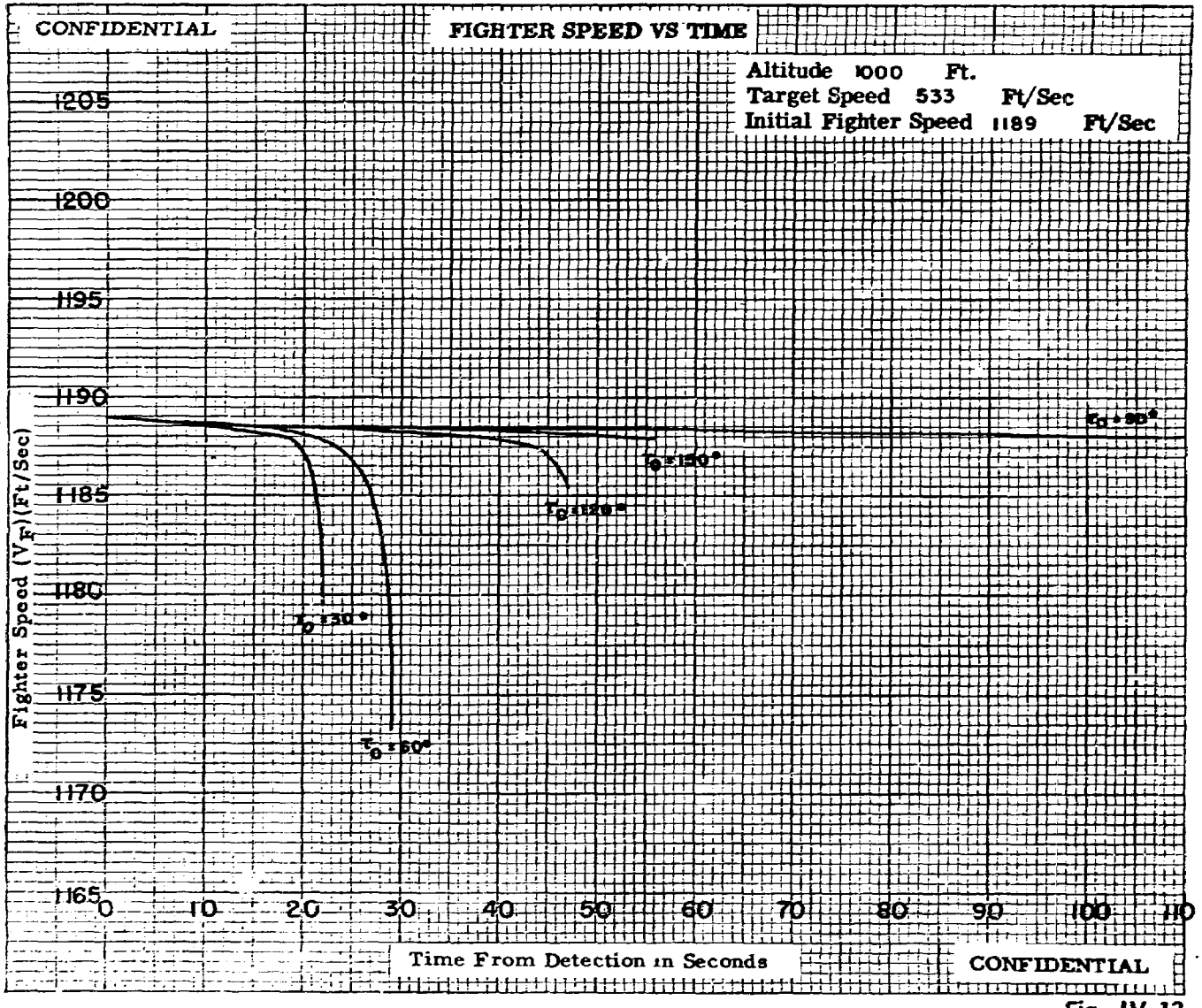
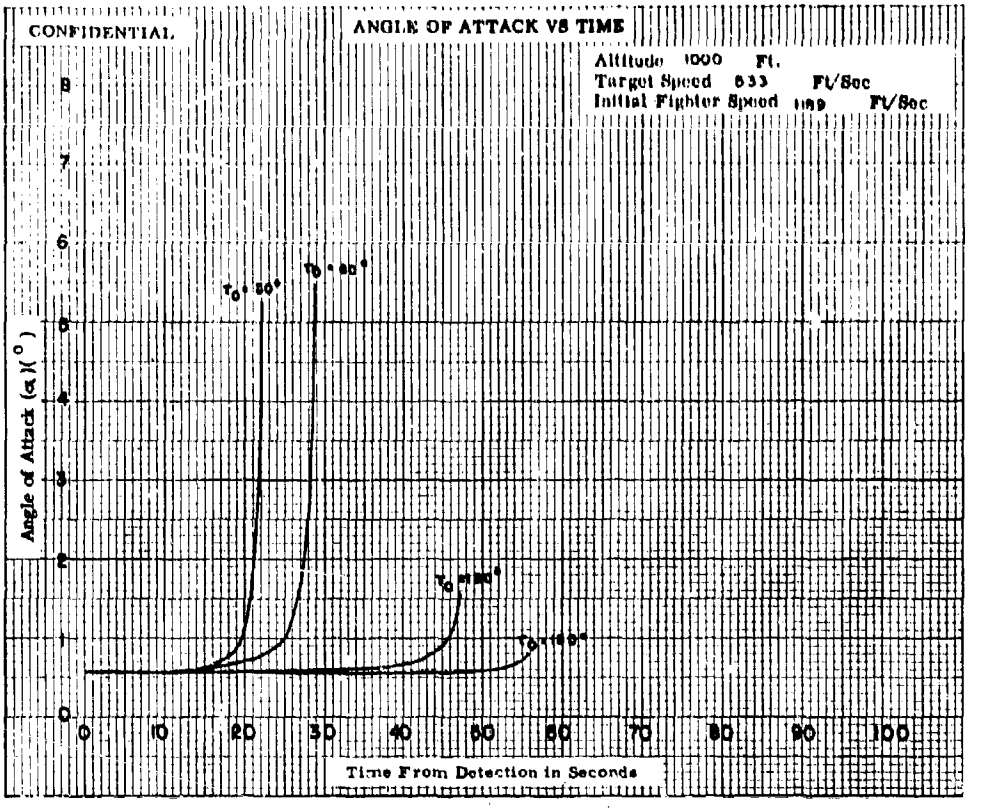

CONFIDENTIAL
FIGHTER SPEED VS TIME
Altitude 1000 Ft.
Target Speed 533 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
1205
1200
1195
1190
1185
1180
1175
1170
1165
Fighter Speed (V_F)(Ft/Sec)
τ_0 = 90°
τ_0 = 150°
τ_0 = 120°
τ_0 = 30°
τ_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
110
Time From Detection in Seconds
CONFIDENTIAL

Fig. IV-13


CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 1000 Ft.
Target Speed 833 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Angle of Attack (α)(°)
Time From Detection in Seconds

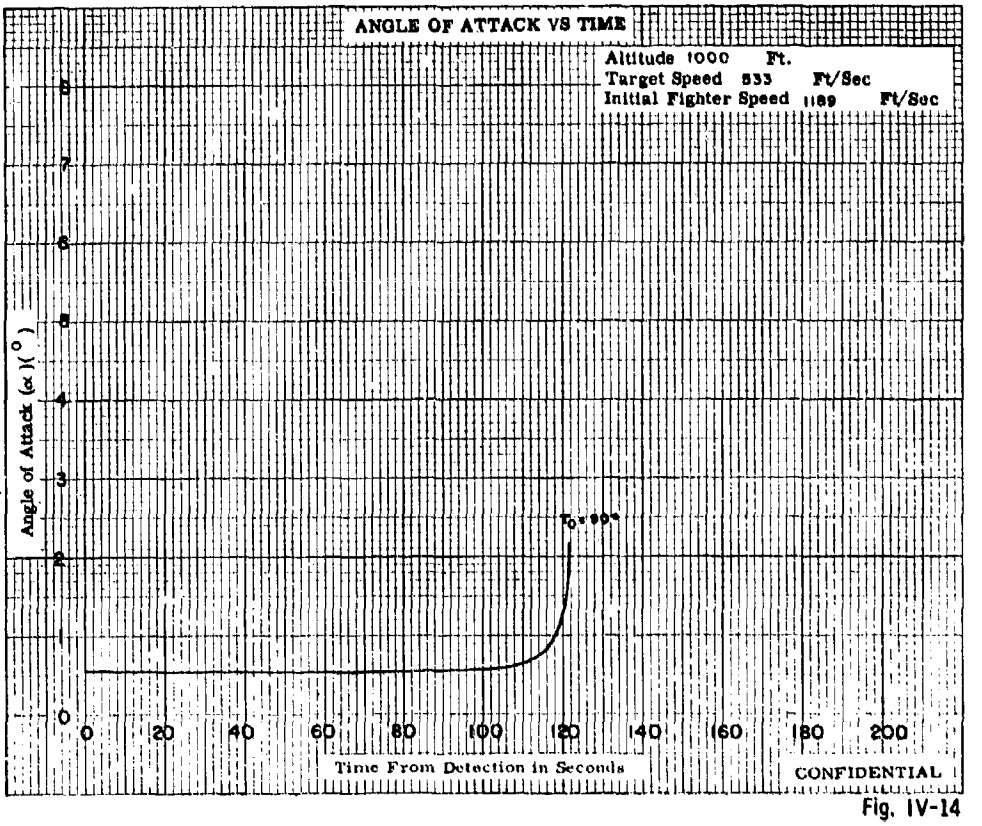
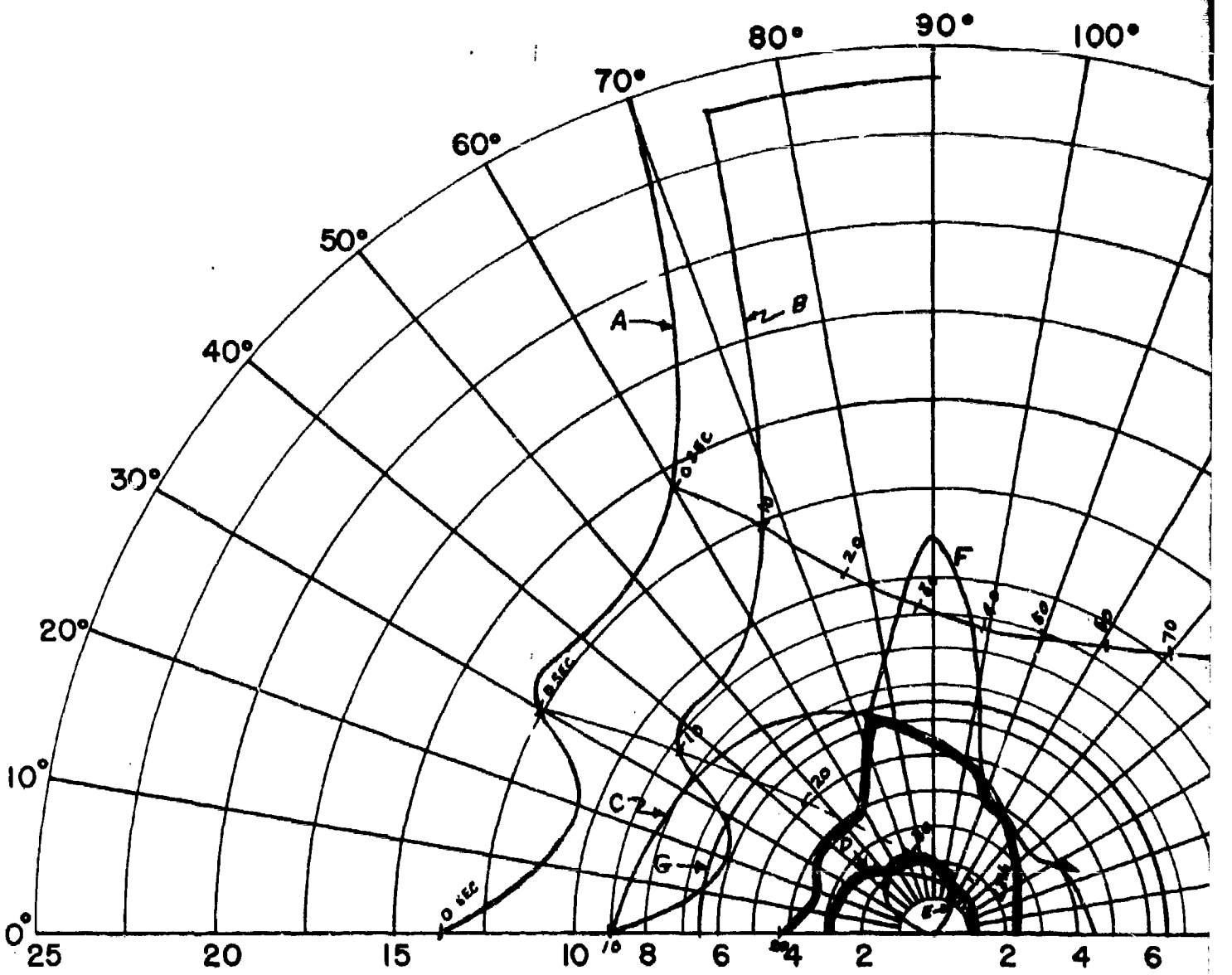

ANGLE OF ATTACK VS TIME
Altitude 1000 Ft.
Target Speed 833 Ft/Sec
Initial Fighter Speed 1189 Ft/Sec
Angle of Attack (α)(°)
Time From Detection in Seconds
CONFIDENTIAL

Fig. IV-14

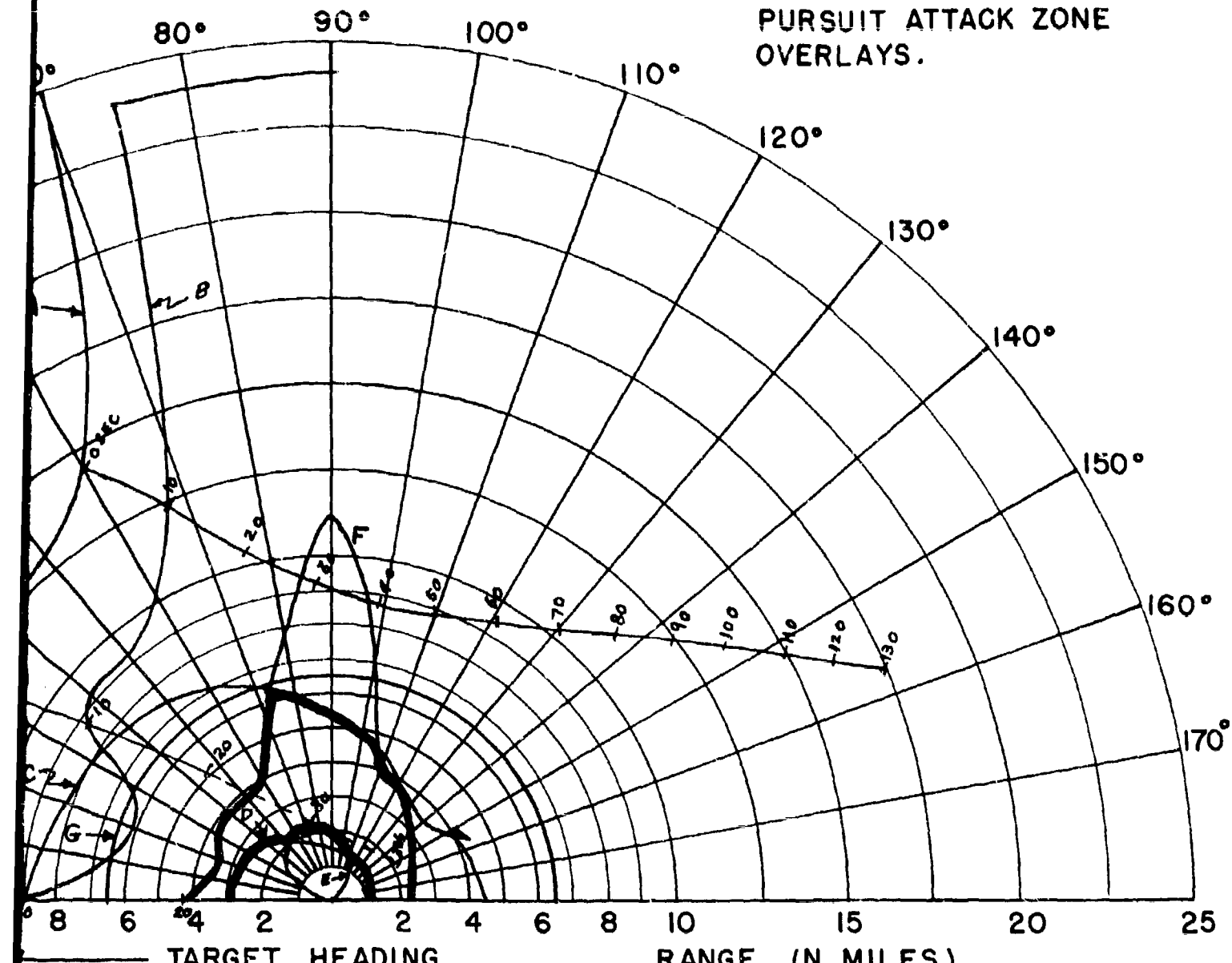


V_F = 873 FT/SEC (F4H-1)(F8U-3)
V_T = 1940 FT/SEC
ALTITUDE = 50,000 FT.
INCREASED THRUST AT DETECTION

← TARGET HEADING

A - 85% DETECTION RANGE
B - LOCK-ON RANGE (10 SEC. LOCK-ON
C - SPARROW III MAX. AERODYNAMIC R
D - SPARROW III MIN. AERODYNAMIC R
E - CONSTANT LOAD FACTOR LOCUS (
F - 90% SPARROW III SEEKER LOCK-O
G - 6.5 N.M. INTERLOCK

FIG. V - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS.



- 85% DETECTION RANGE
- LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
- SPARROW III MAX. AERODYNAMIC RANGE
- SPARROW III MIN. AERODYNAMIC RANGE
- CONSTANT LOAD FACTOR LOCUS ($N_Z = 3$)
- 90% SPARROW III SEEKER LOCK-ON RANGE
- 6.5 N.M. INTERLOCK

CONFIDENTIAL

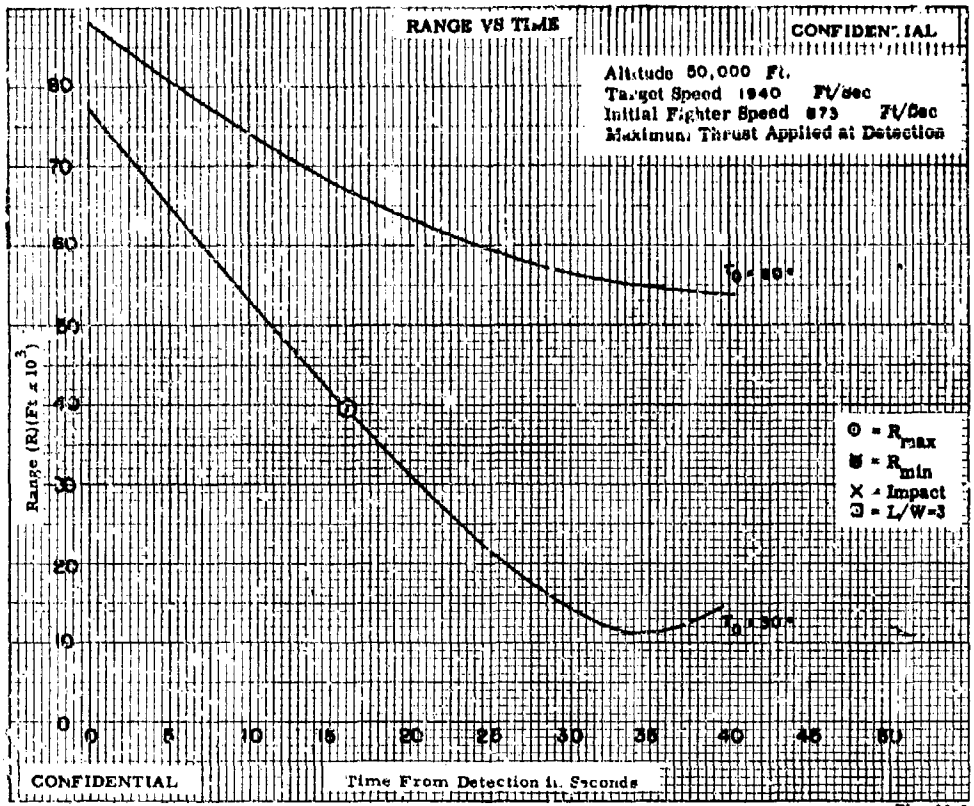

RANGE VS TIME
CONFIDENTIAL
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Range (R)(Ft x 10^3)
Time From Detection in Seconds
CONFIDENTIAL

Fig. V-1

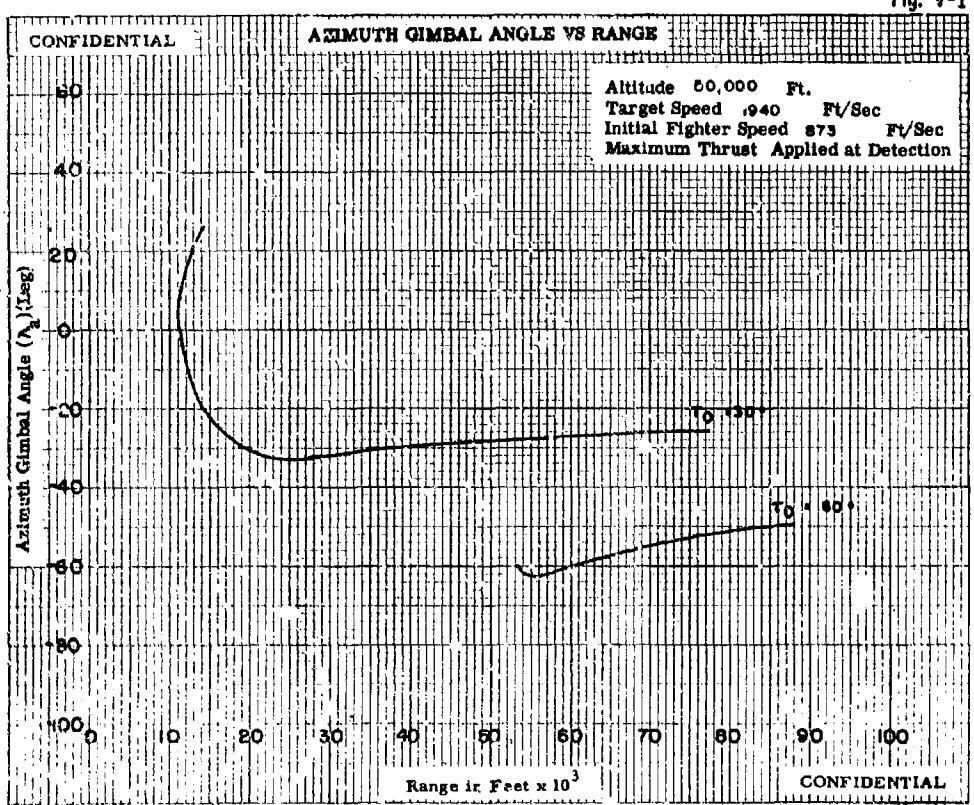

CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (A_z)(Deg)
Range in Feet x 10^3
CONFIDENTIAL

Fig. V-2

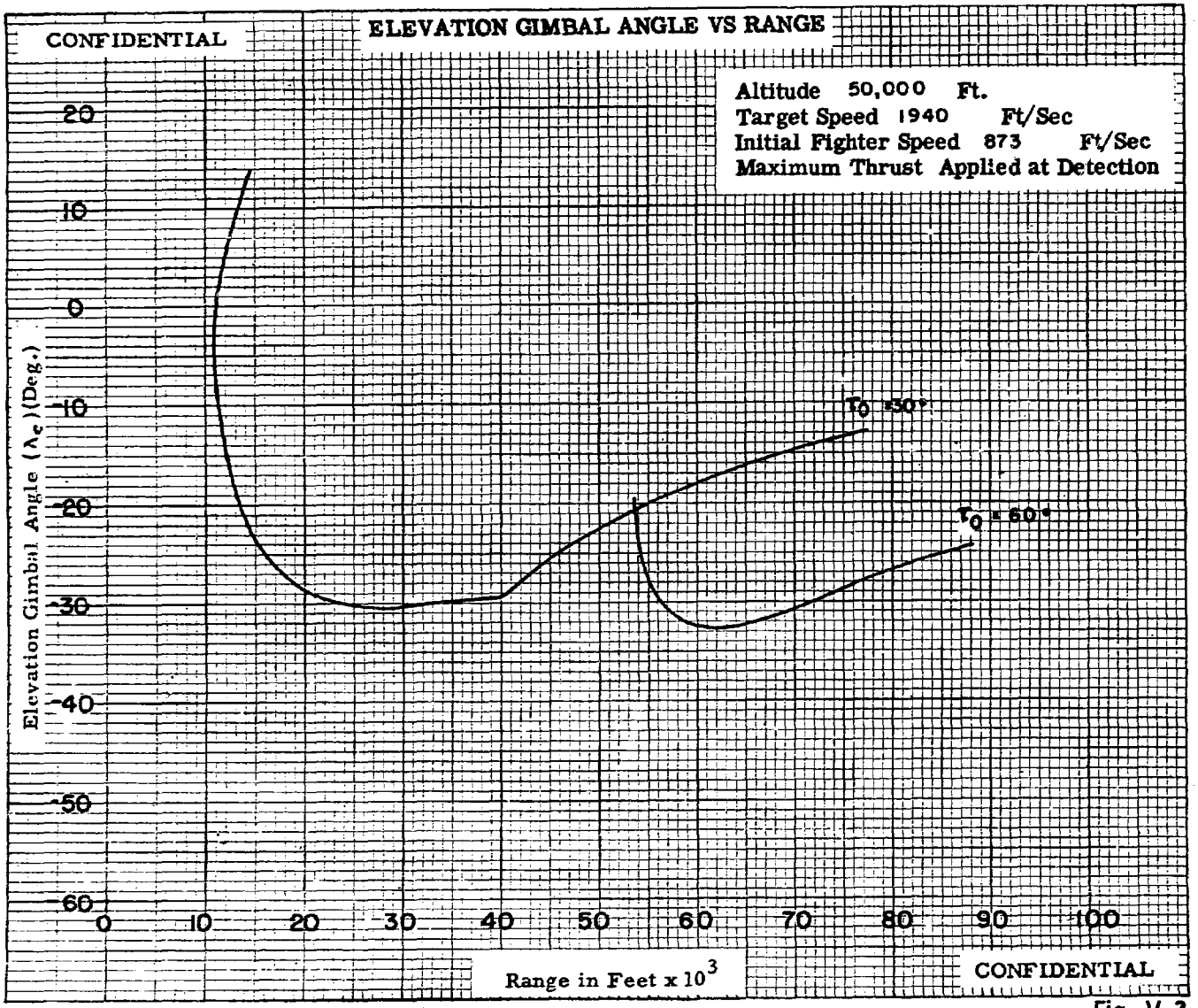
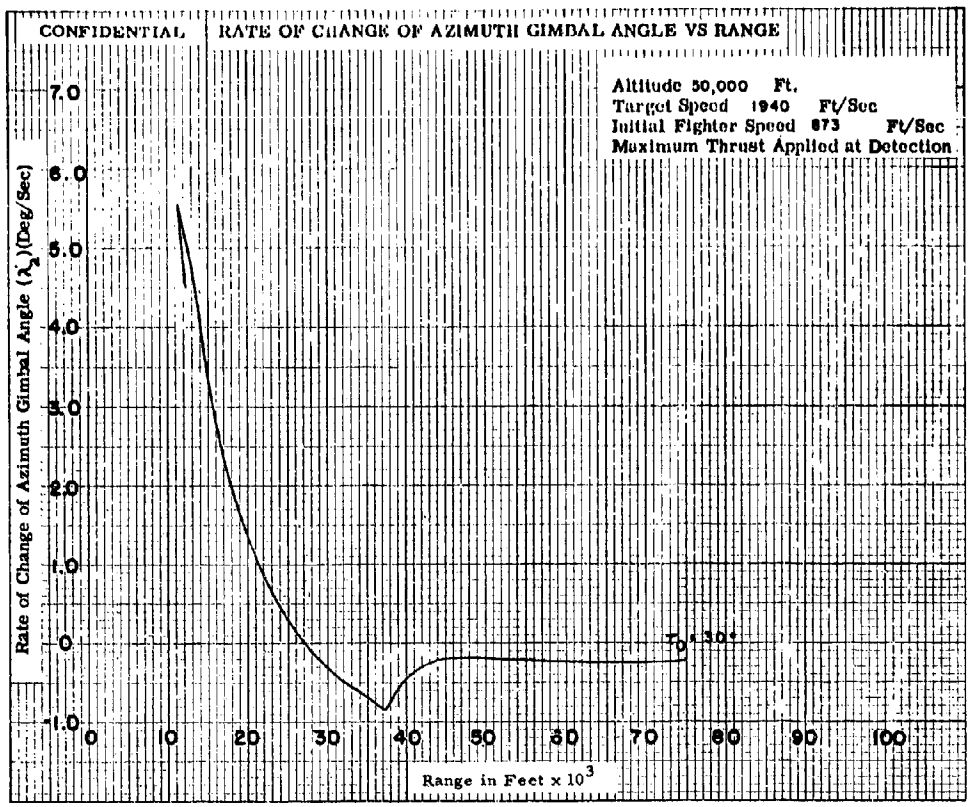

CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Gimbal Angle (Λ_e) (Deg.)
20
10
0
-10
-20
-30
-40
-50
-60
T_0 =50°
T_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. V-3


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle (λ_2)(Deg/Sec)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
τ_0 = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

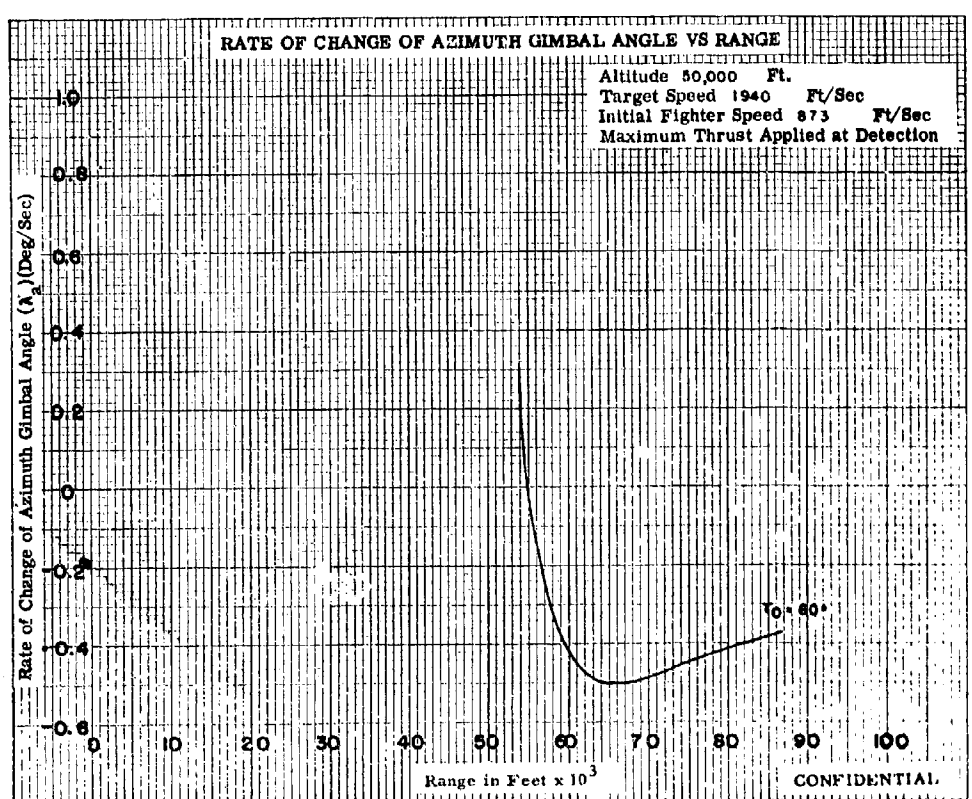
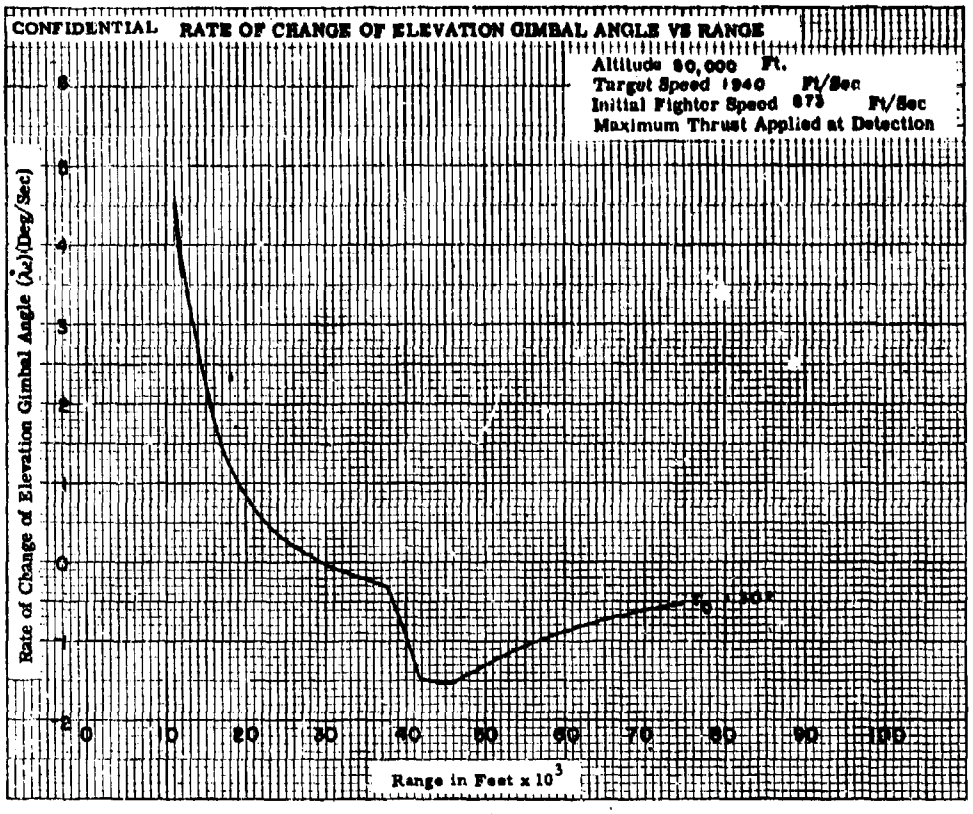

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle (λ_2)(Deg/Sec)
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
τ_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. V-4

CONFIDENTIAL



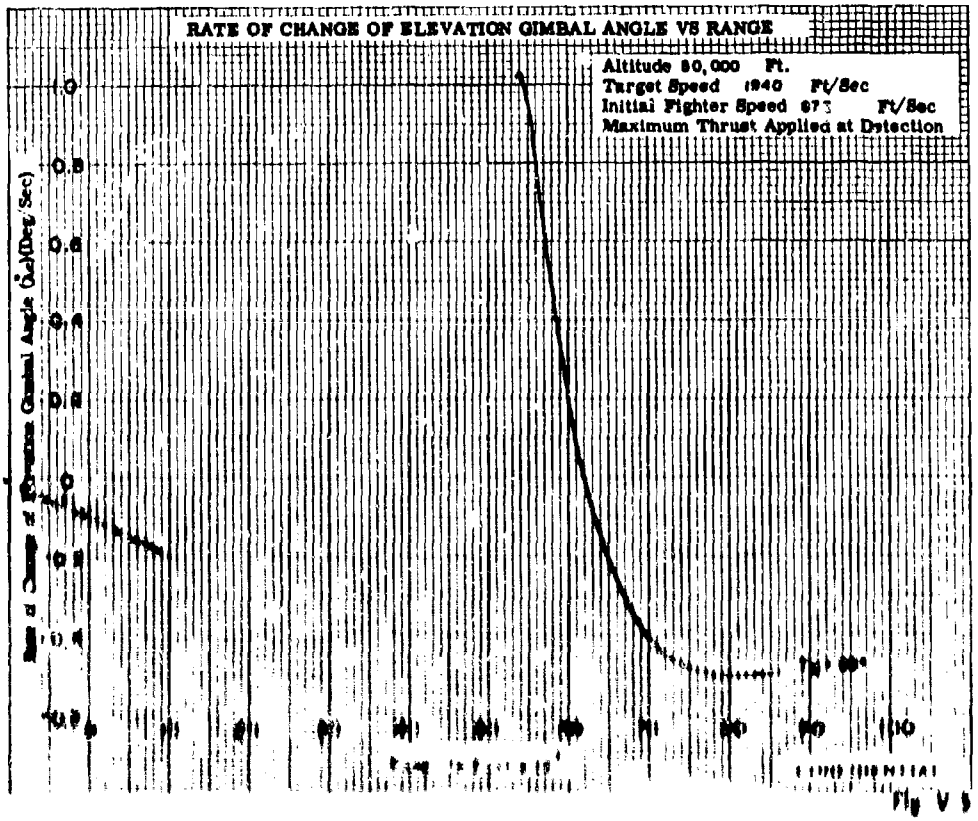


Fig V 5

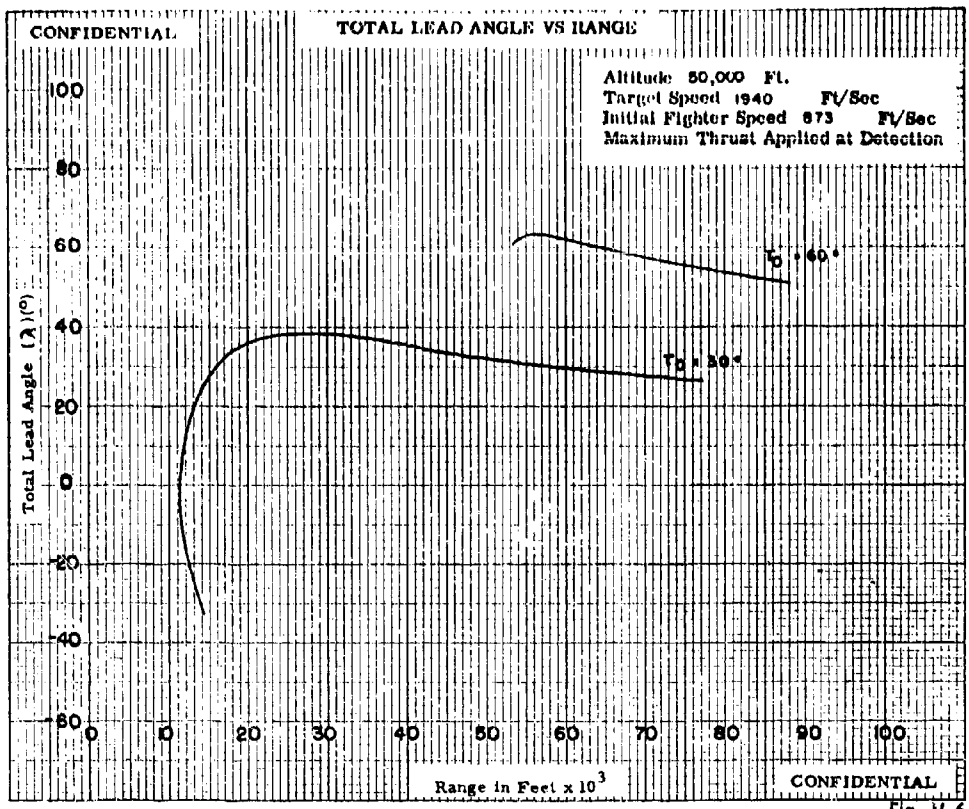

CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Total Lead Angle (λ)(°)
100
80
60
40
20
0
-20
-40
-60
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. V-6

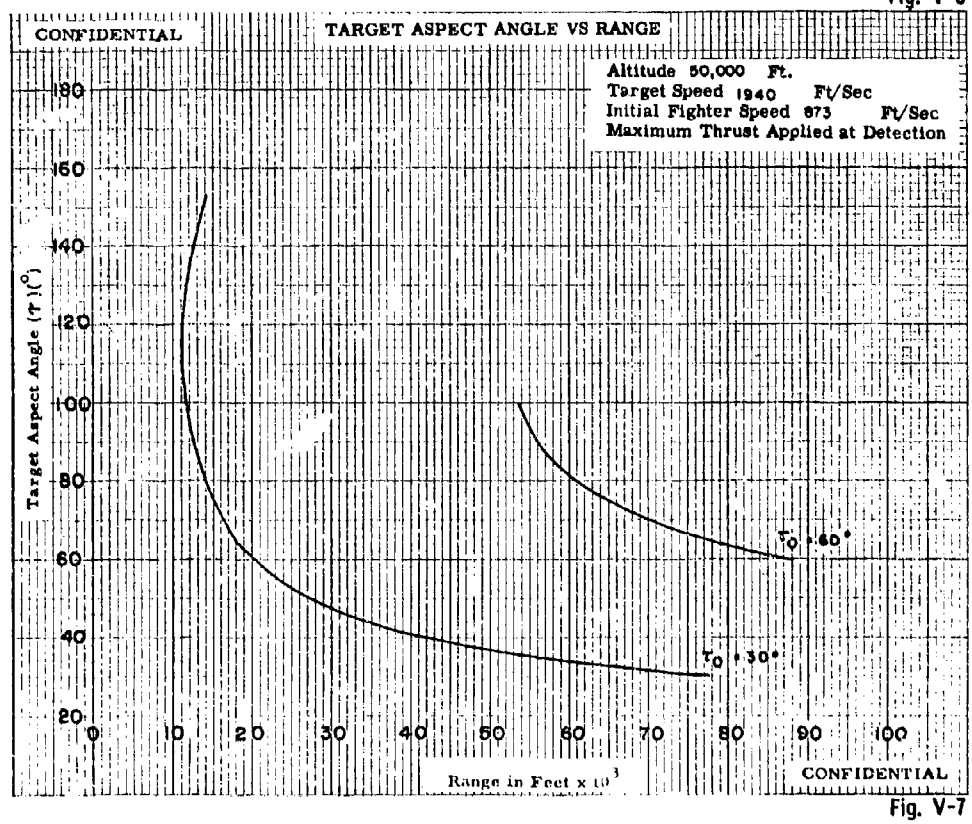

CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Target Aspect Angle (τ)(°)
180
160
140
120
100
80
60
40
20
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. V-7

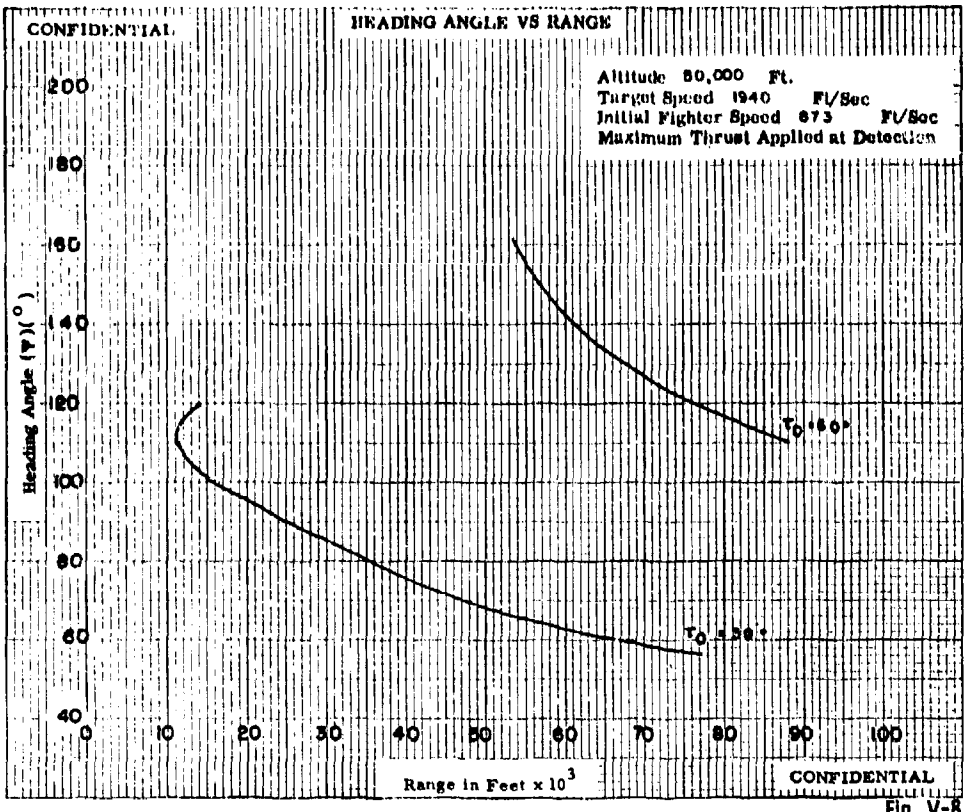

CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Heading Angle (ψ)(°)
200
180
160
140
120
100
80
60
40
0
10
20
30
40
50
60
70
80
90
100
τ_0 =60°
τ_0 =30°
Range in Feet x 10^3
CONFIDENTIAL

Fig. V-8

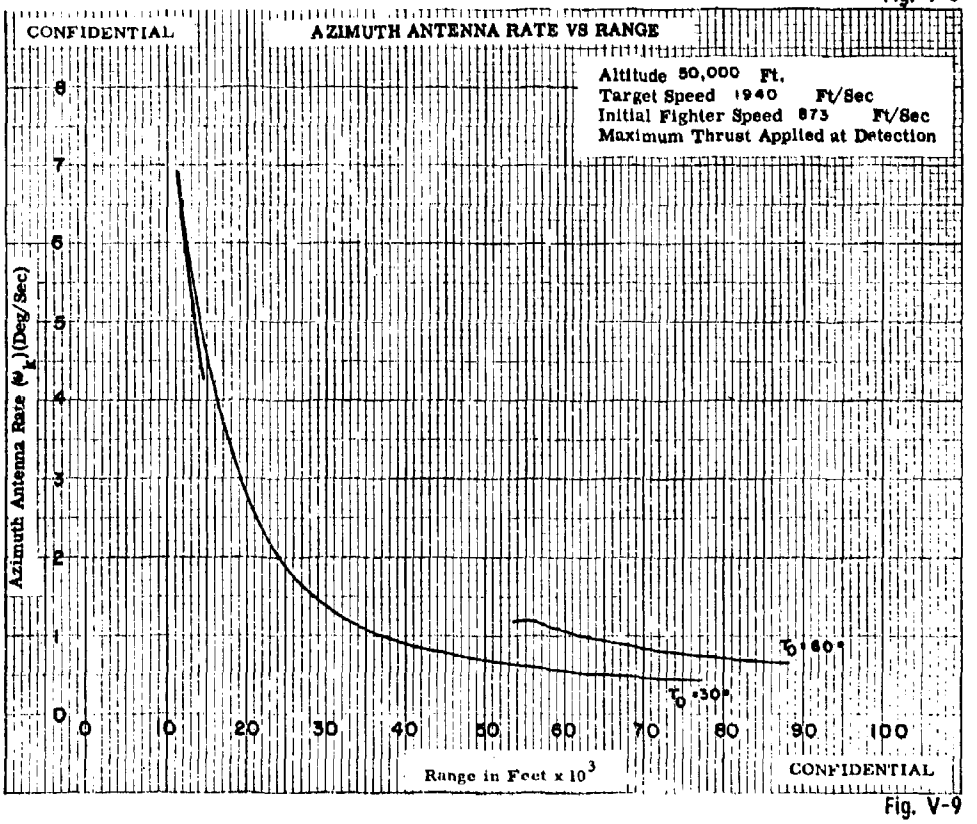

CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Antenna Rate ($\dot{\psi}_k$)(Deg/Sec)
8
7
6
5
4
3
2
1
0
0
10
20
30
40
50
60
70
80
90
100
τ_0 =60°
τ_0 =30°
Range in Feet x 10^3
CONFIDENTIAL

Fig. V-9

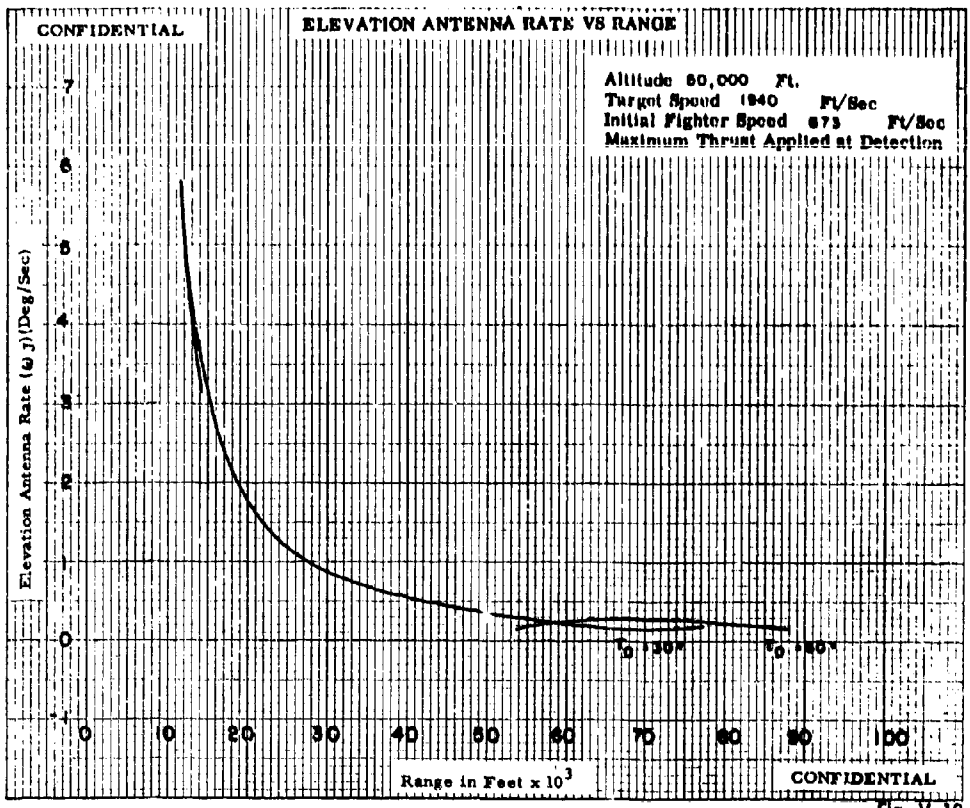


Fig. V-10

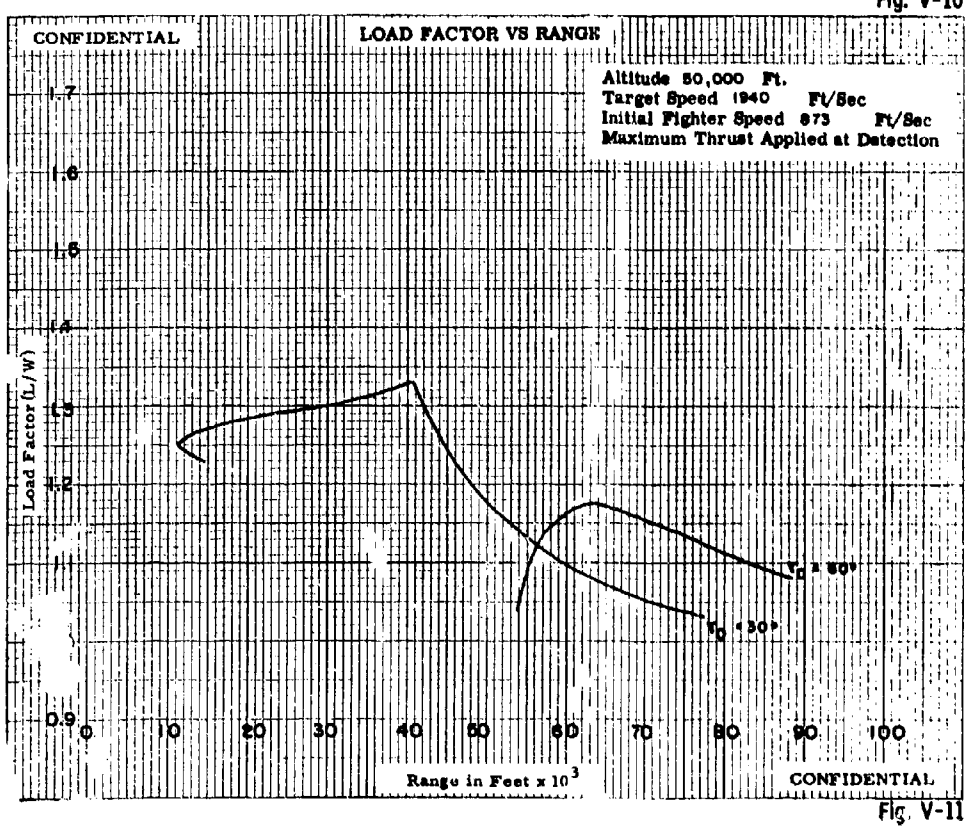


Fig. V-11

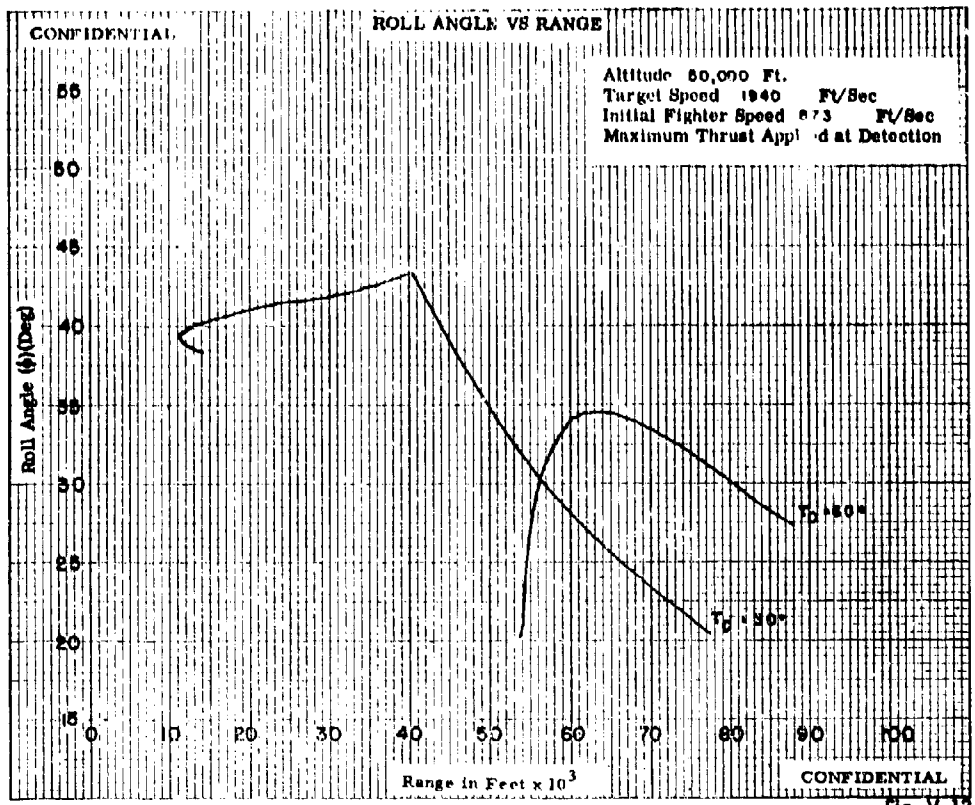


Fig. V-12

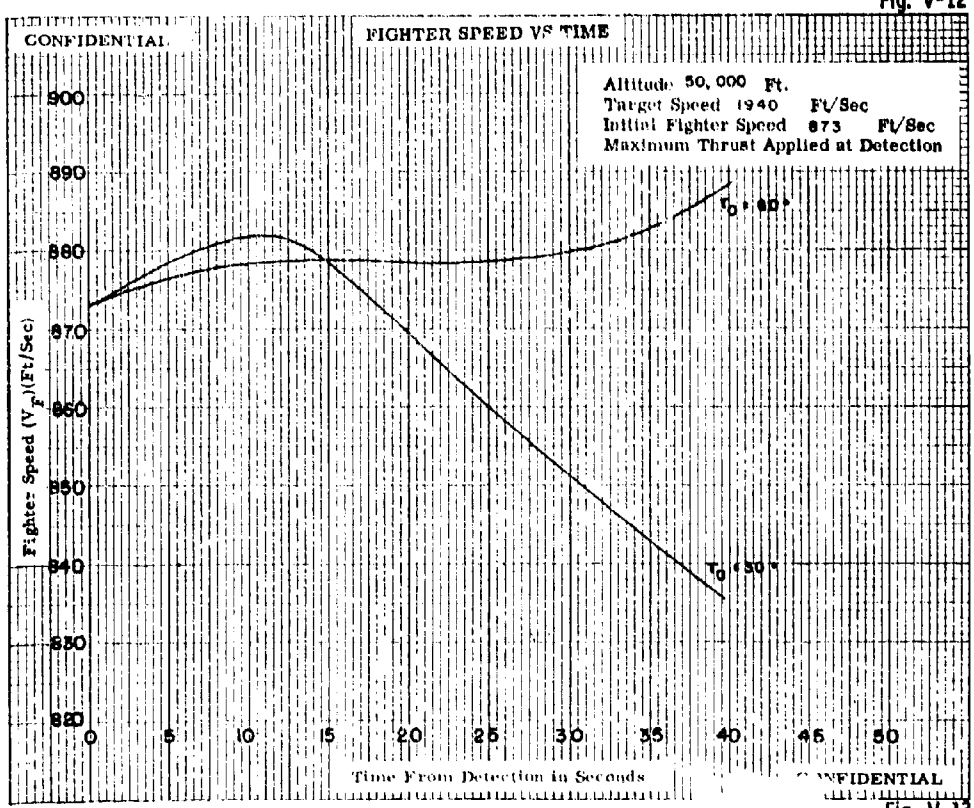


Fig. V-13

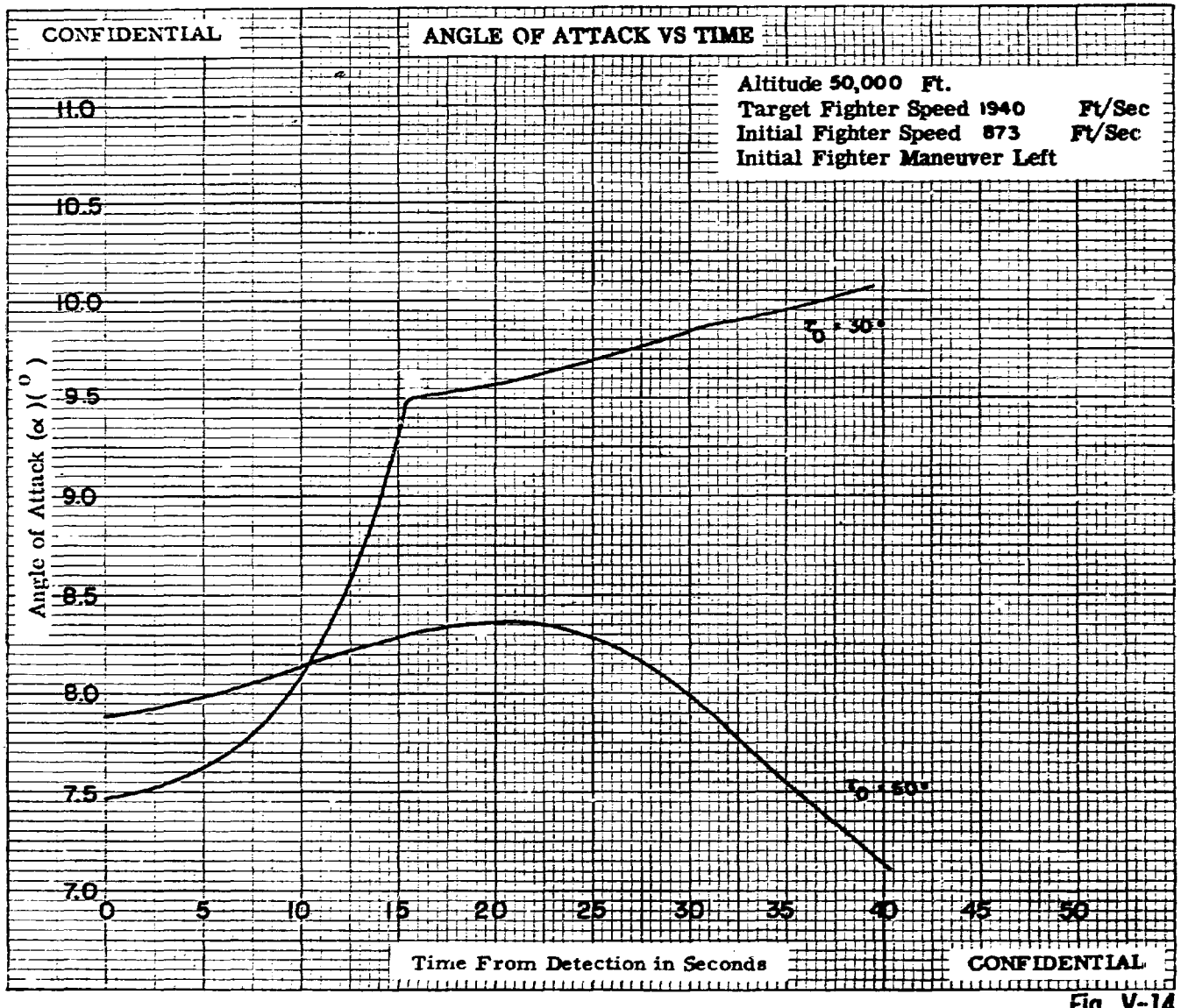
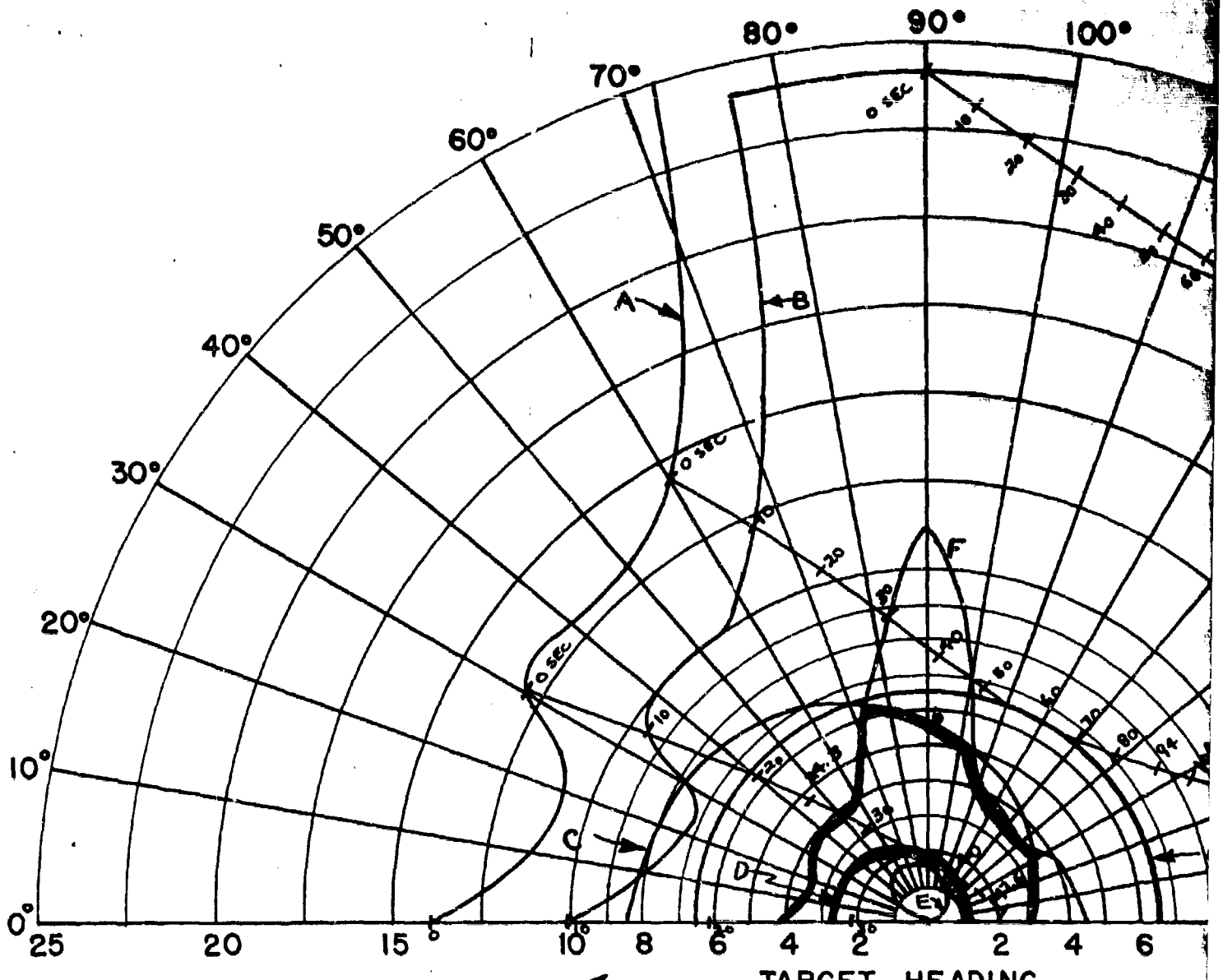

CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 50,000 Ft.
Target Fighter Speed 1940 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Initial Fighter Maneuver Left
Angle of Attack (α)(°)
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
0
5
10
15
20
25
30
35
40
45
50
τ_0 = 30°
τ_0 = 50°
Time From Detection in Seconds
CONFIDENTIAL

Fig. V-14



V_F = 873 FT/SEC (F4H-1)(F8U-3)

V_T = 1552 FT/SEC

ALTITUDE = 50,000 FT.

INCREASED THRUST AT DETECTION

← TARGET HEADING

A - 85% DETECTION RANGE

B - LOCK-ON RANGE (10 SEC. LOCK-ON T

C - SPARROW III MAX. AERODYNAMIC R

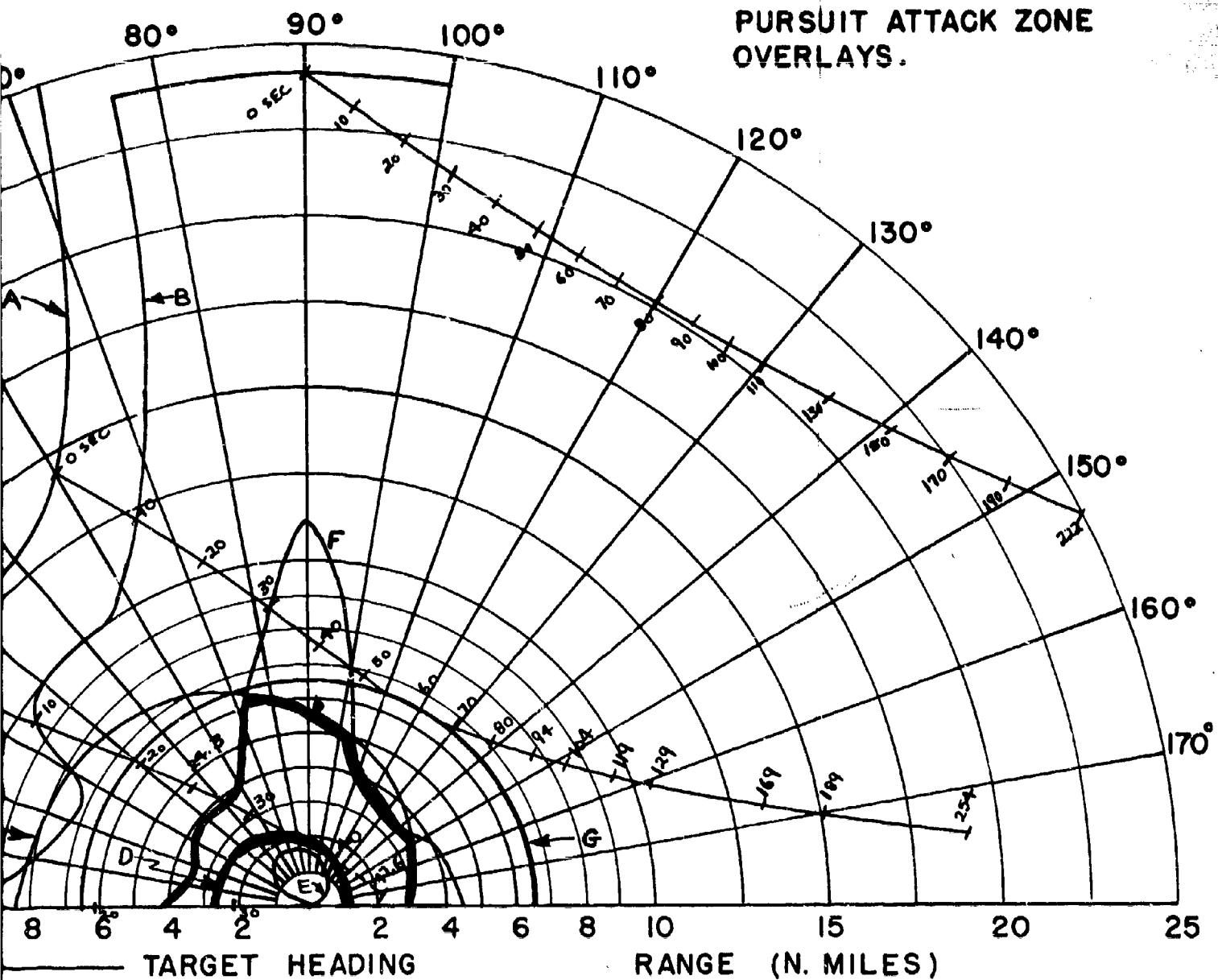
D - SPARROW III MIN. AERODYNAMIC R

E - CONSTANT LOAD FACTOR LOCUS (

F - 90% SPARROW III SEEKER LOCK-O

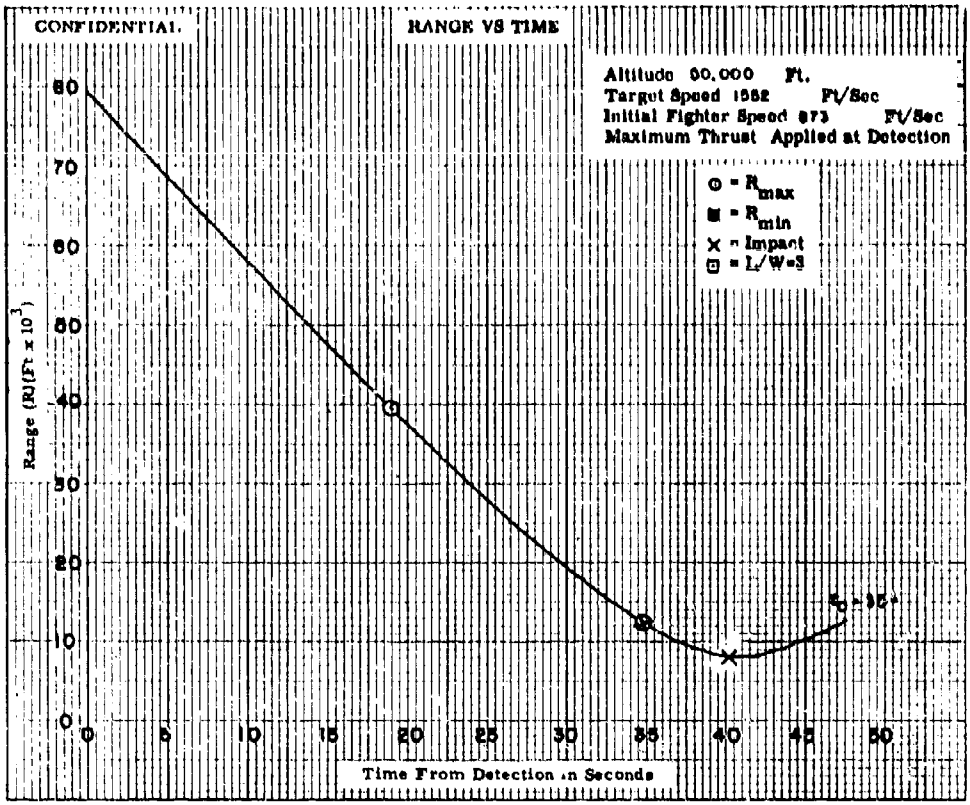
G - 6.5 N.M. INTERLOCK

FIG. VI - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS.



85% DETECTION RANGE
LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
SPARROW III MAX. AERODYNAMIC RANGE
SPARROW III MIN. AERODYNAMIC RANGE
CONSTANT LOAD FACTOR LOCUS ($N_z = 3$)
90% SPARROW III SEEKER LOCK-ON RANGE
6.5 N.M. INTERLOCK

CONFIDENTIAL


CONFIDENTIAL
RANGE VS TIME
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
⊙ = R_{max}
■ = R_{min}
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10^3)
Time From Detection in Seconds
ζ_0 = 35°

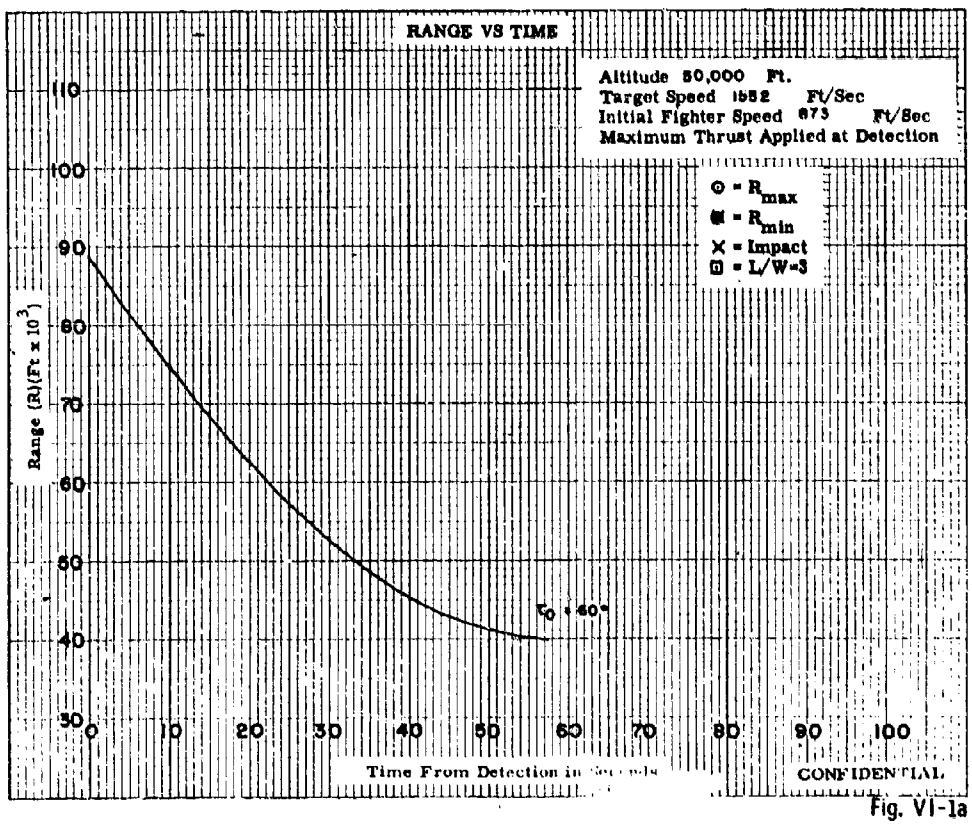

RANGE VS TIME
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
⊙ = R_{max}
■ = R_{min}
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10^3)
ζ_0 = 40°
Time From Detection in Seconds
CONFIDENTIAL

Fig. VI-1a

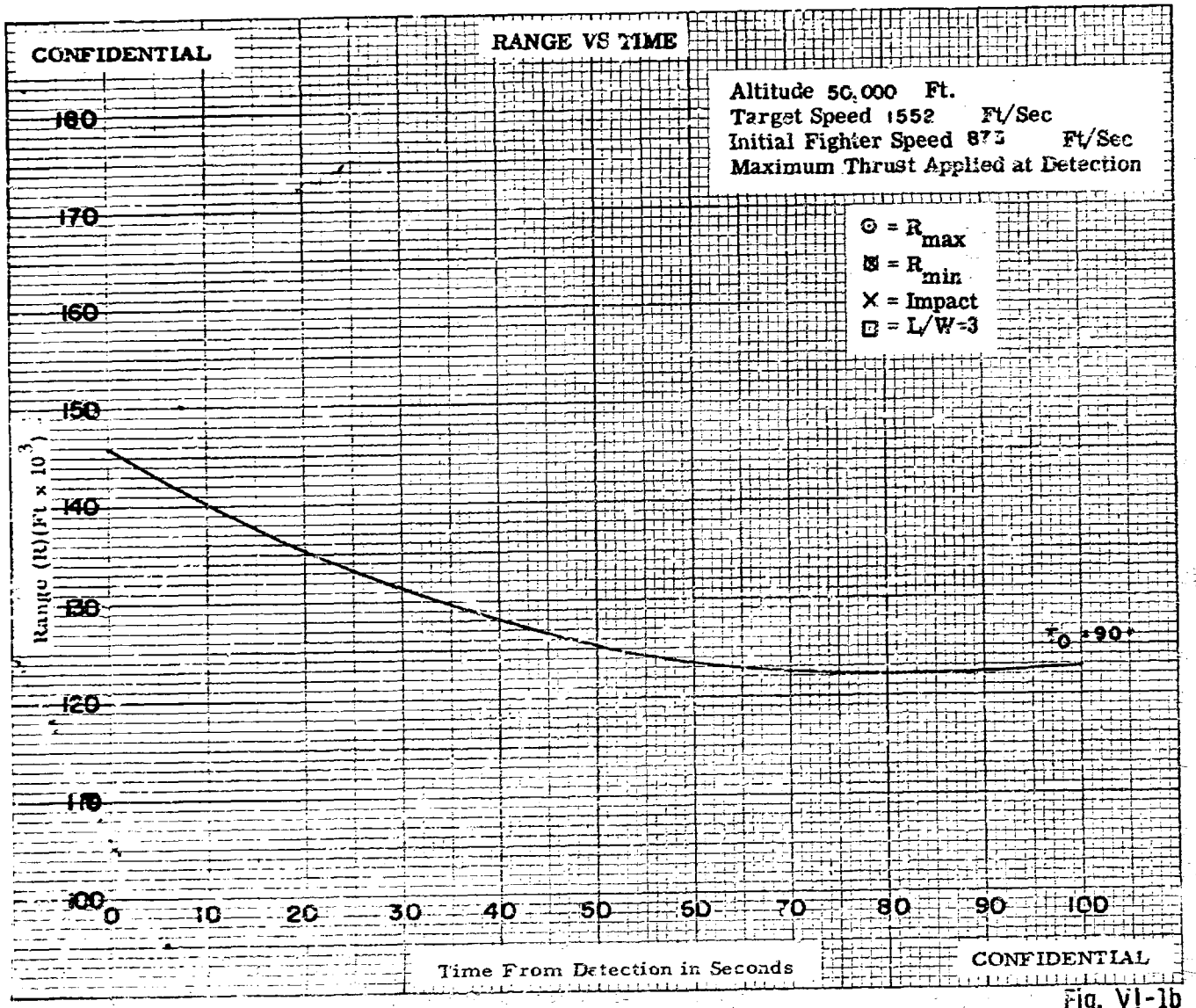
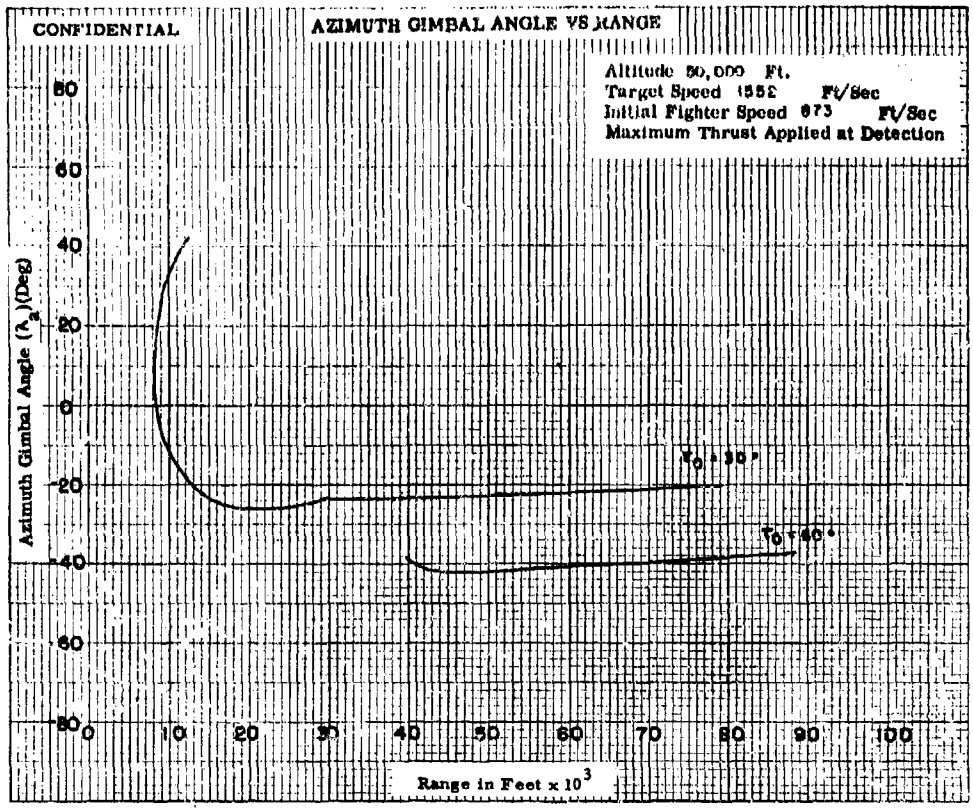

CONFIDENTIAL
RANGE VS TIME
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 875 Ft/Sec
Maximum Thrust Applied at Detection
⊙ = R_{max}
⊠ = R_{min}
X = Impact
⊡ = L/W=3
T_0 +90+
Range (R)(Ft x 10^3)
180
170
160
150
140
130
120
110
100
0
10
20
30
40
50
60
70
80
90
100
Time From Detection in Seconds
CONFIDENTIAL

Fig. VI-1b


AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (λ_a)(Deg)
80
60
40
20
0
-20
-40
-60
-80
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
T_0 = 30°
T_0 = 60°

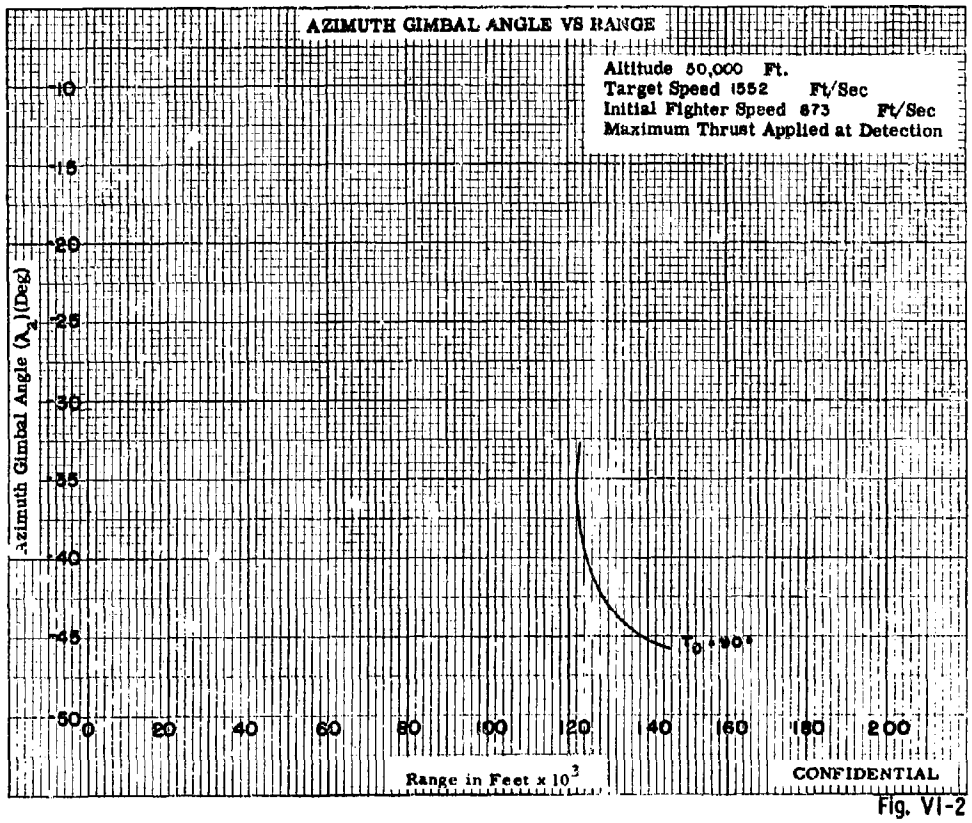
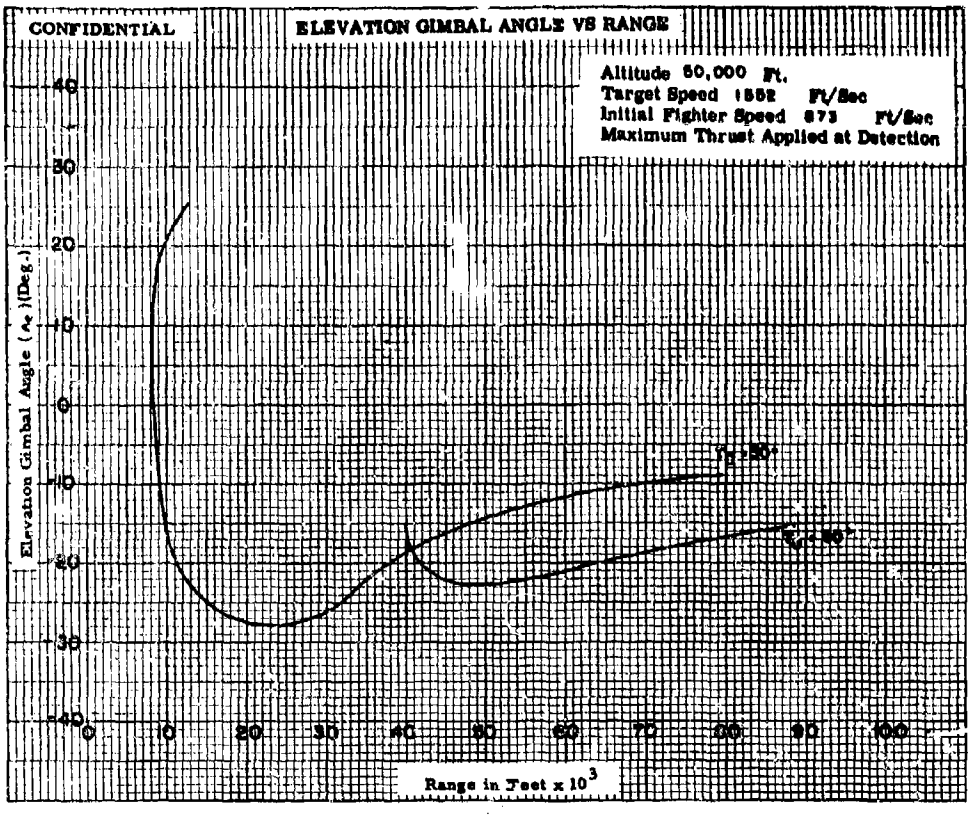

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (λ_a)(Deg)
-10
-15
-20
-25
-30
-35
-40
-45
-50
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
T_0 = 90°
CONFIDENTIAL

Fig. VI-2


CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Gimbal Angle (λe)(Deg.)
Range in Feet x 10^3

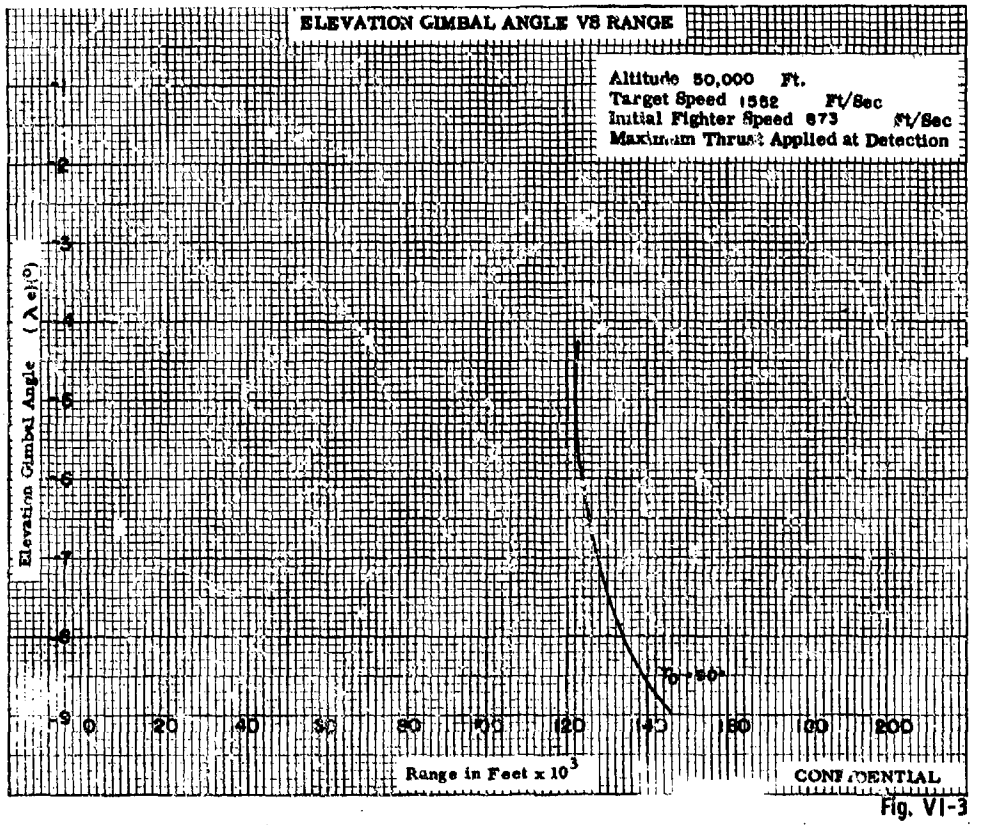
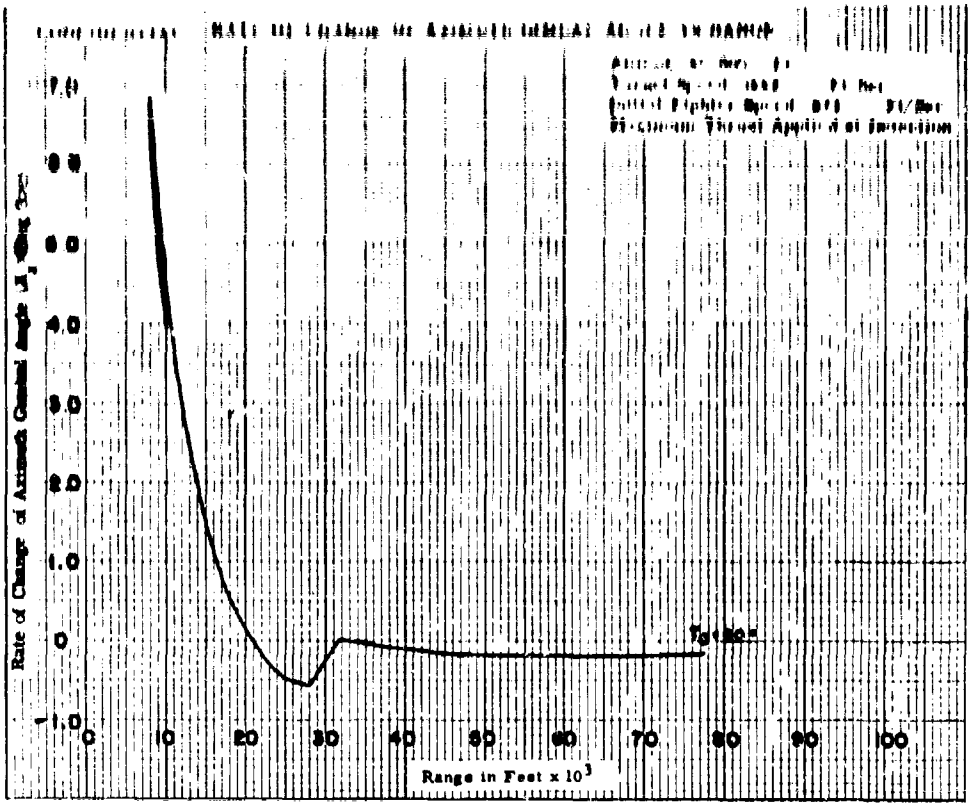

ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Gimbal Angle (λe)(°)
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-3


Rate of Change of Azimuth Gimbal Angle
Range in Feet x 10^3

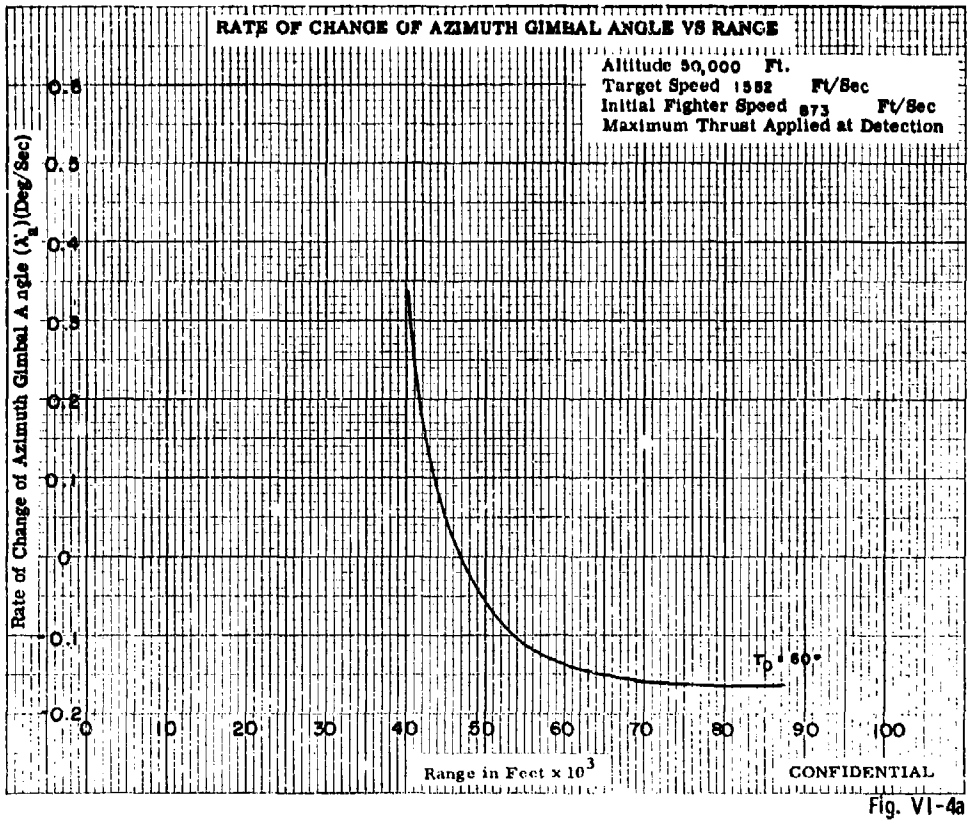

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle (λ_2)(Deg/Sec)
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-4a

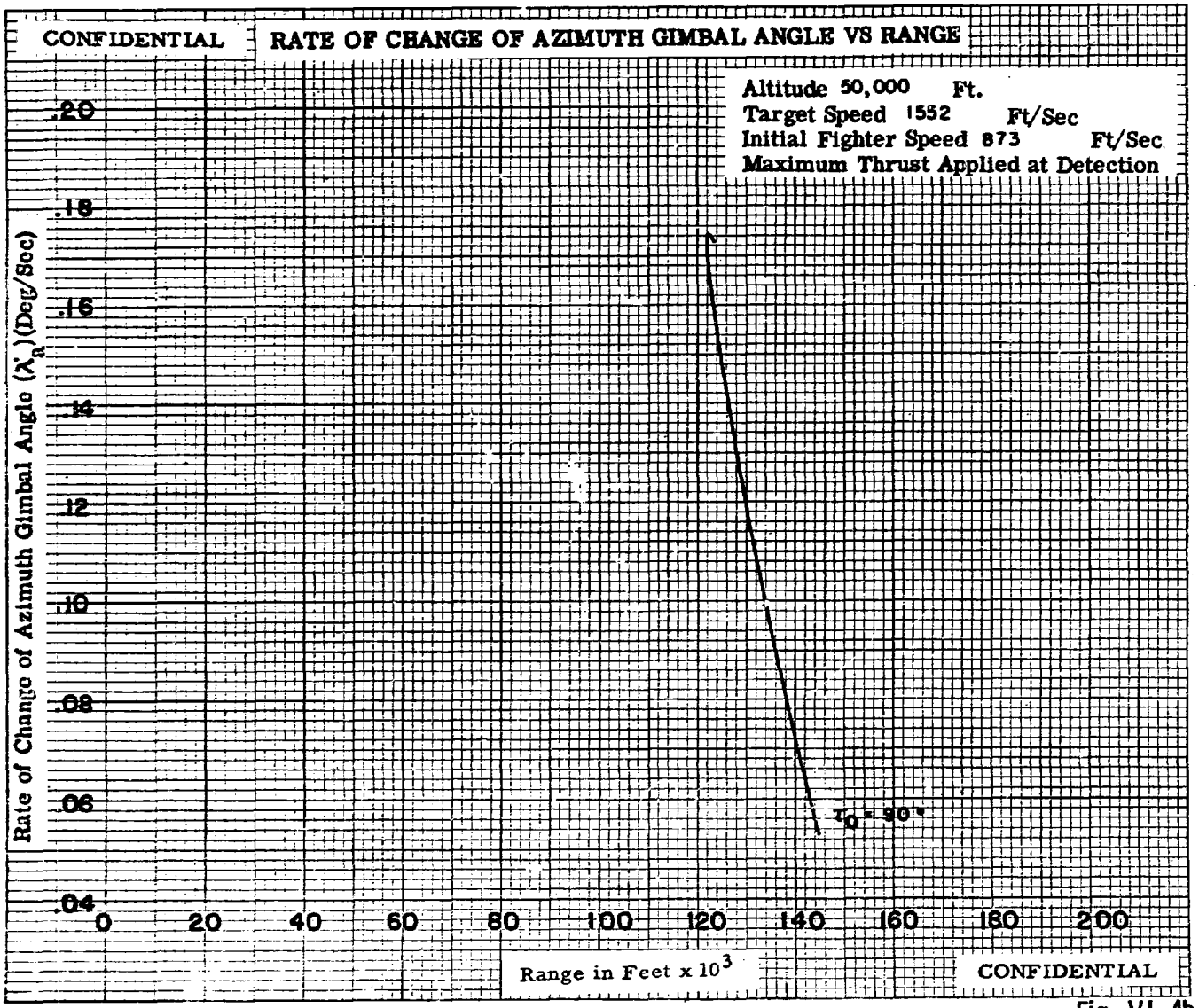
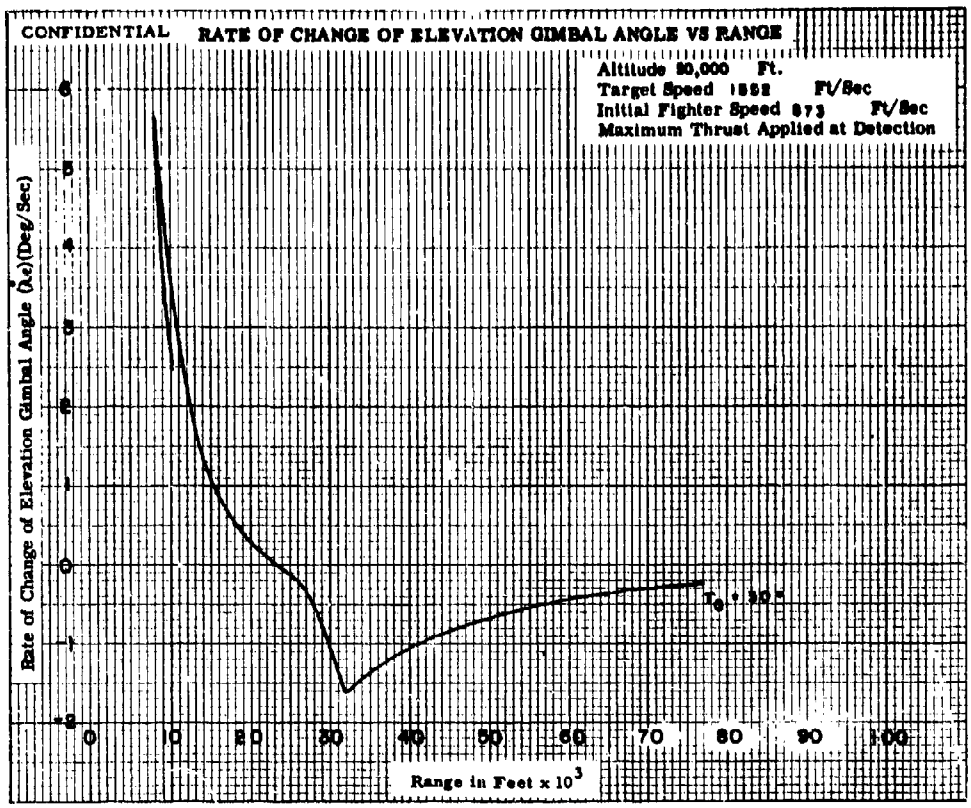

CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle (λ_a)(Deg/Sec)
.20
.18
.16
.14
.12
.10
.08
.06
.04
τ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-4b


CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
Range in Feet x 10^3
T_D = 30°

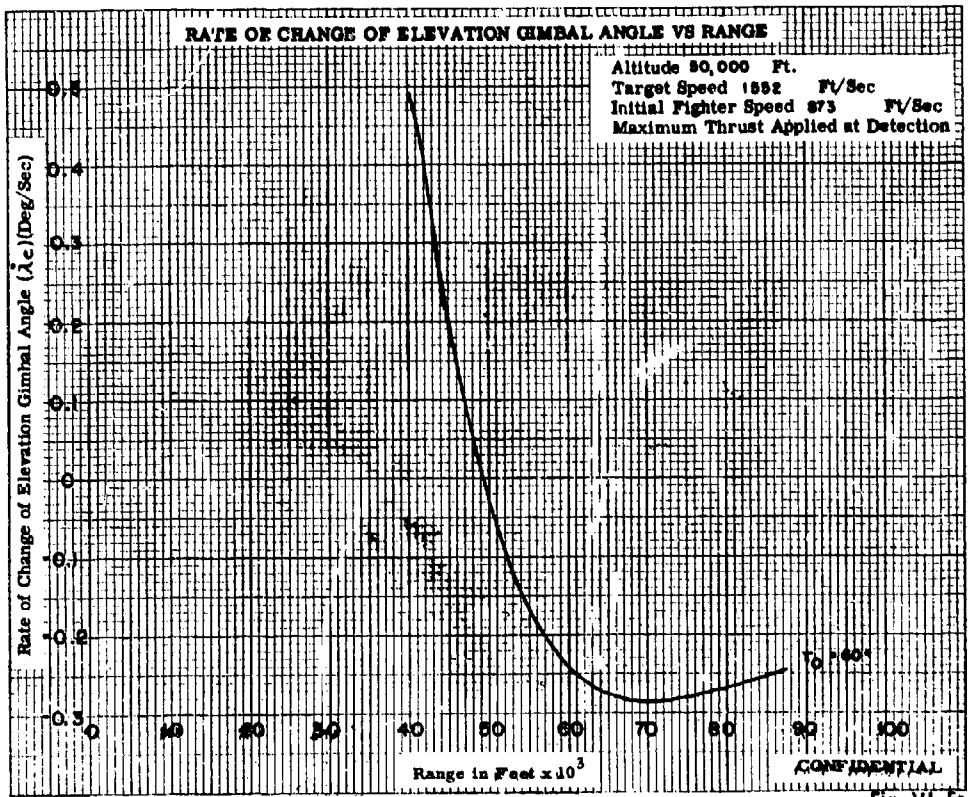

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
Range in Feet x 10^3
T_D = 60°
CONFIDENTIAL

Fig. VI-5a

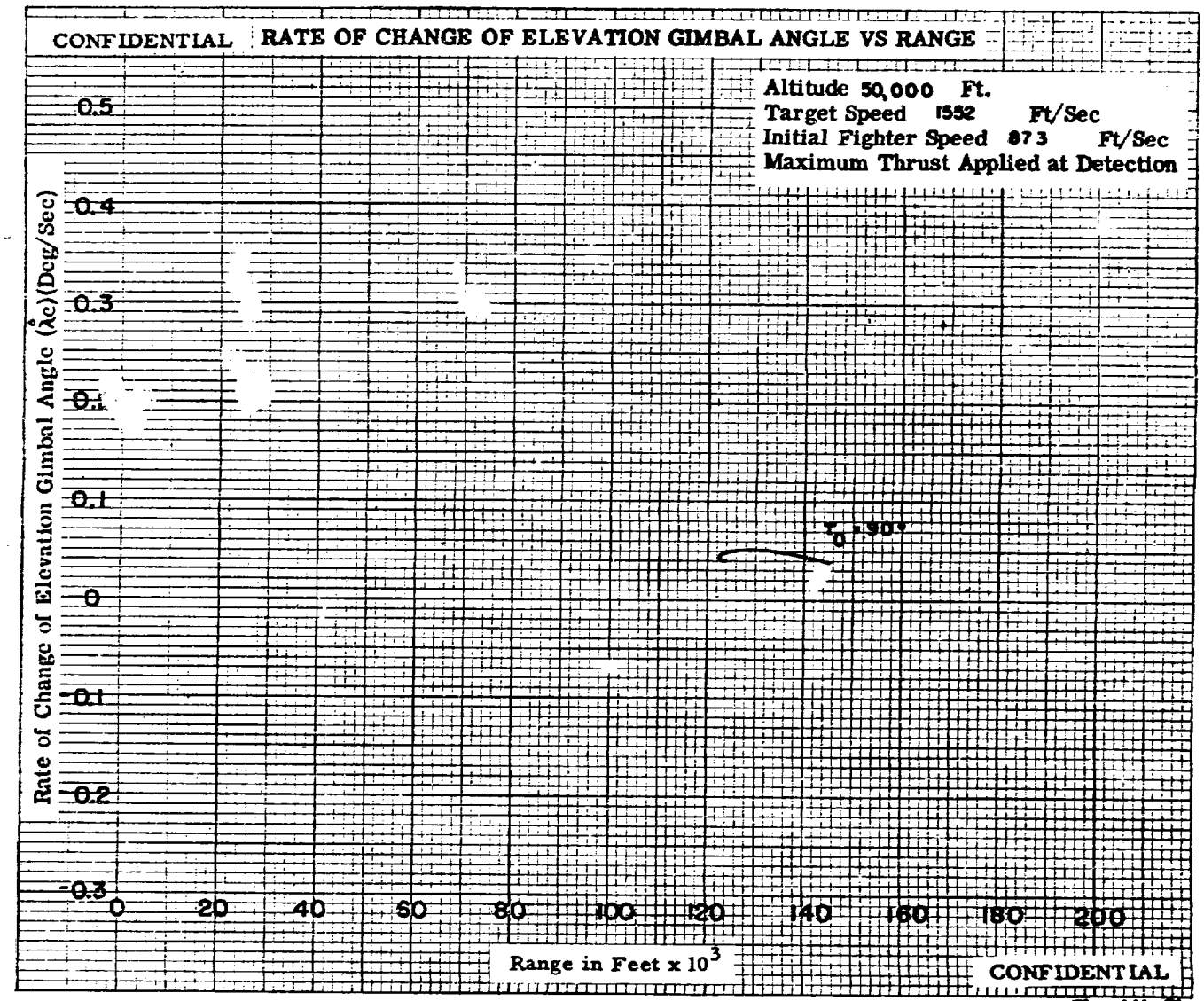
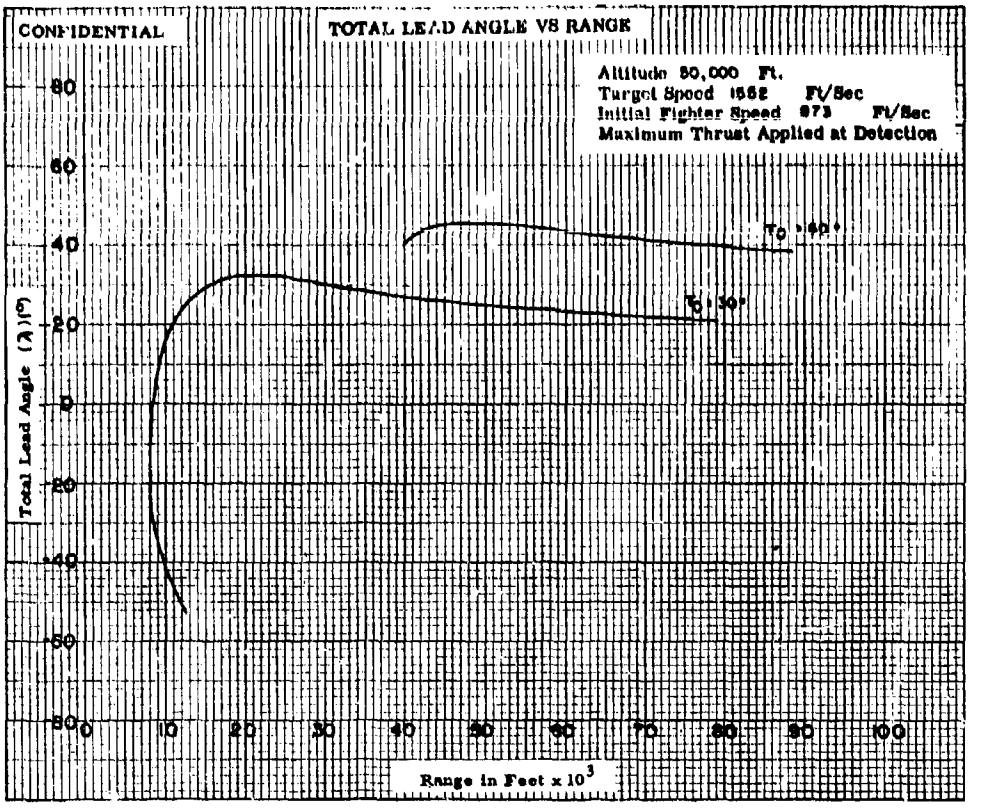

CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle (λ̇c)(Deg/Sec)
0.5
0.4
0.3
0.1
0.1
0
0.1
0.2
-0.3
0
20
40
60
80
100
120
140
160
180
200
τ_0 = 90°
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-5b


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Total Lead Angle (λ)(°)
80
60
40
20
0
-20
-40
-60
-80
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10³

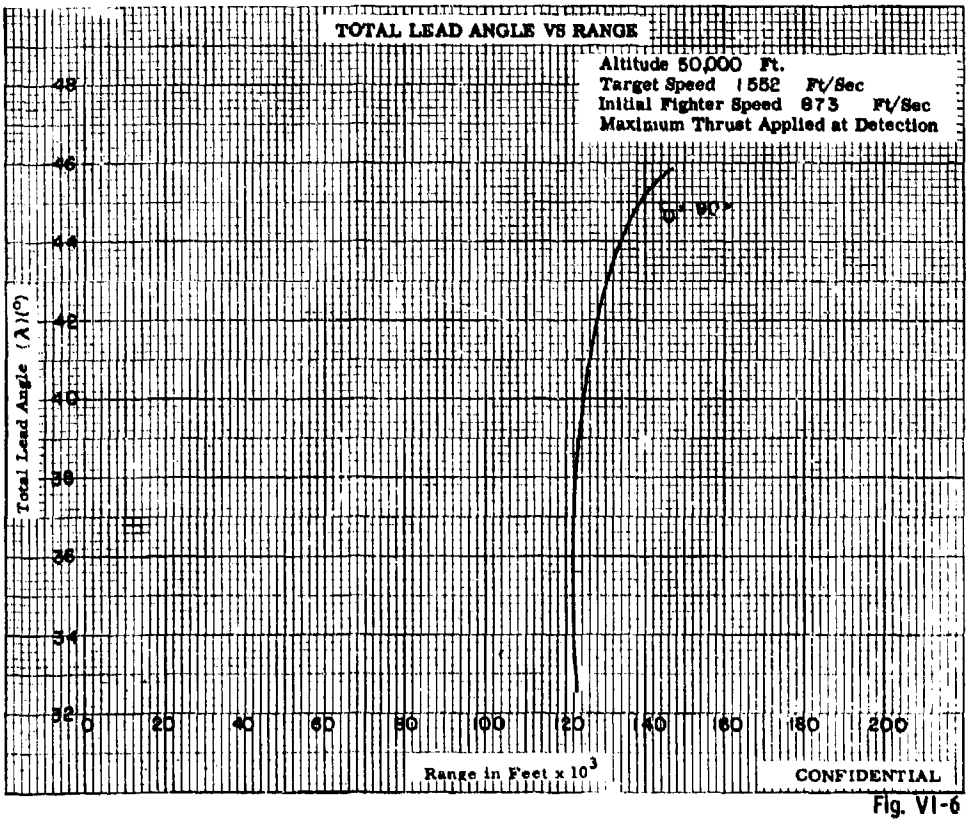
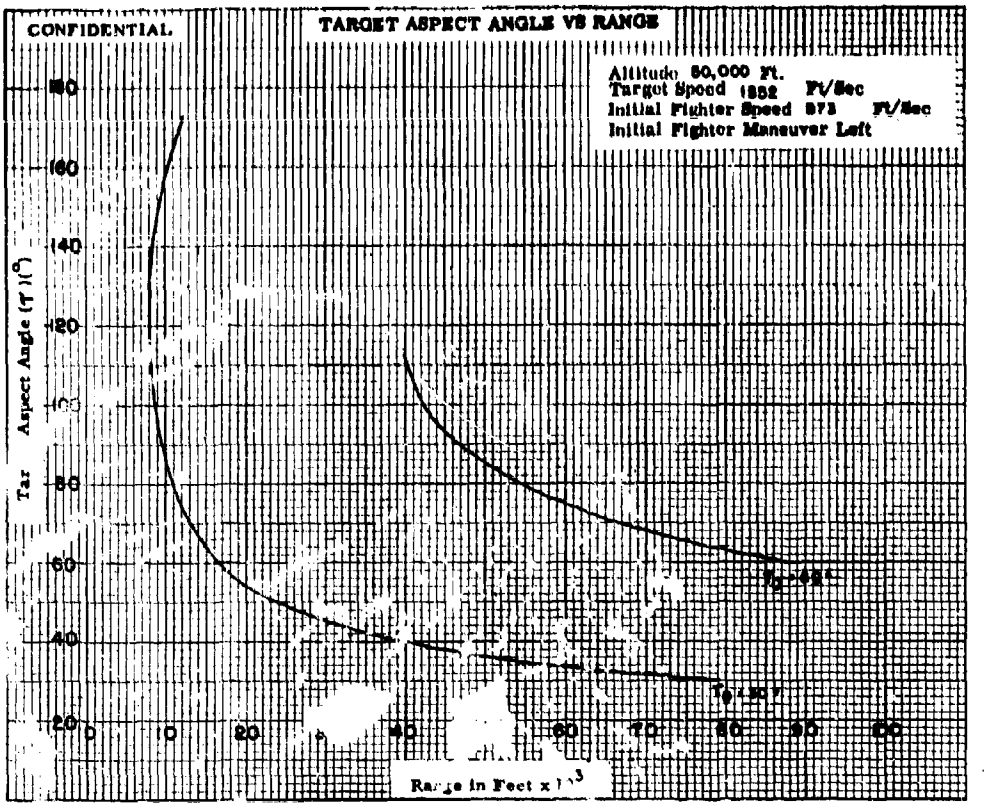

TOTAL LEAD ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Total Lead Angle (λ)(°)
48
46
44
42
40
38
36
34
32
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10³
CONFIDENTIAL

Fig. VI-6


CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Initial Fighter Maneuver Left
Tar Aspect Angle (T)(°)
180
160
140
120
100
80
60
40
20
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

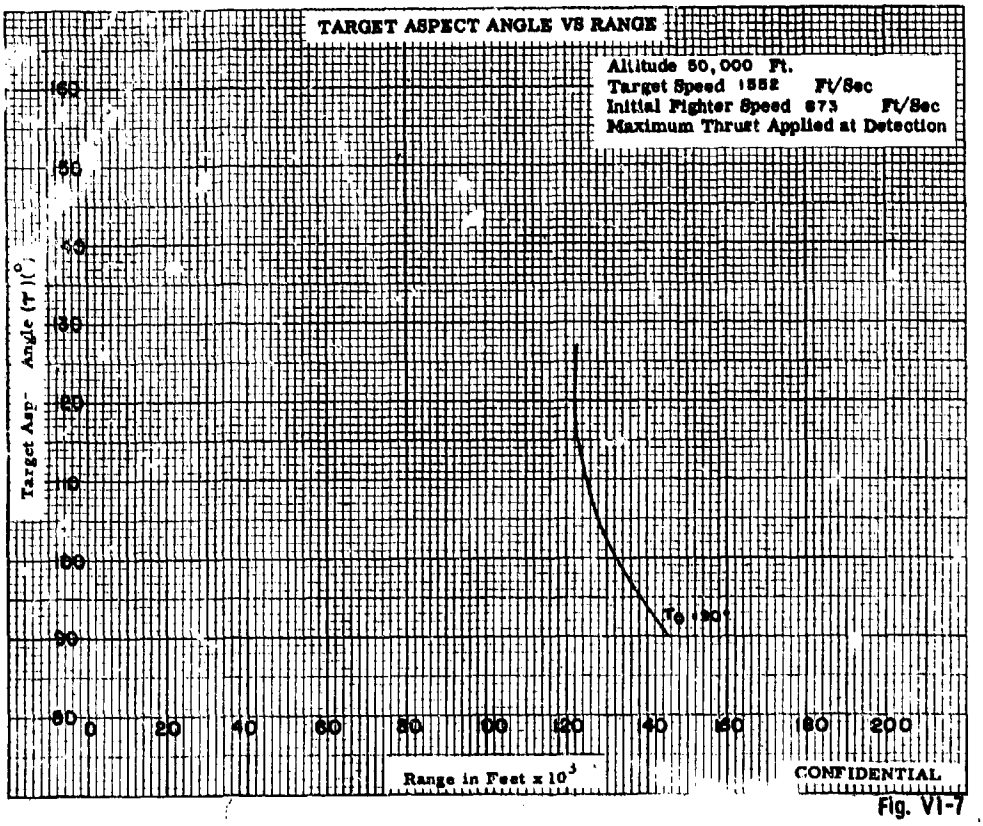
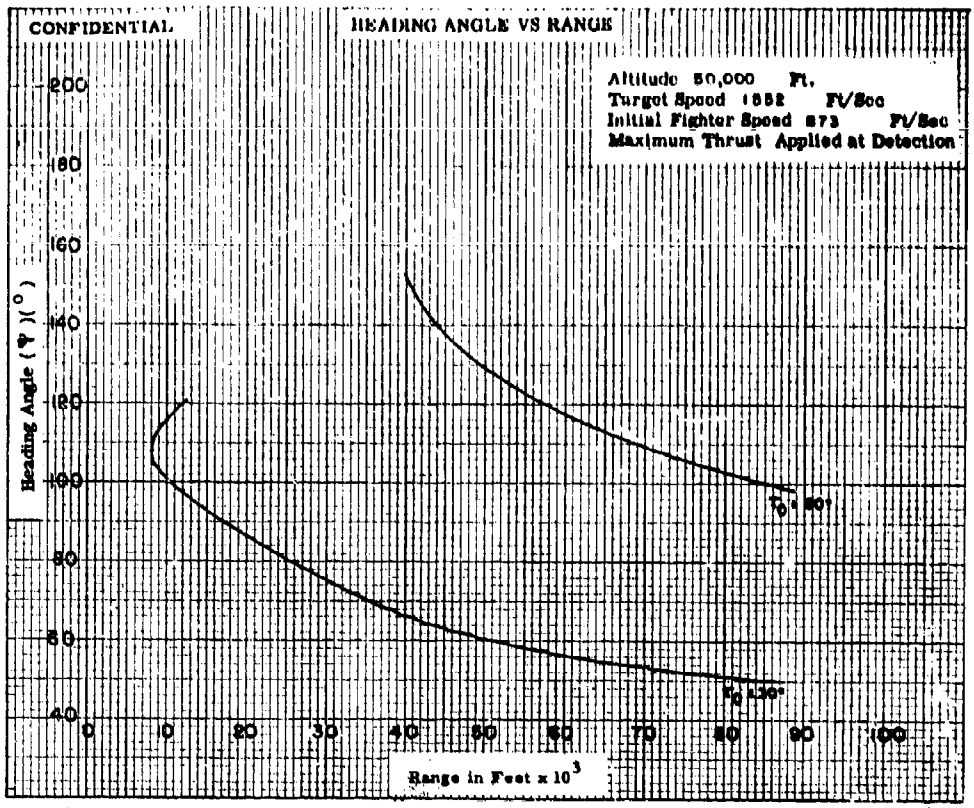

TARGET ASPECT ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Target Asp- Angle (T)(°)
60
50
40
30
20
10
0
90
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-7


CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Heading Angle (Ψ)(°)
200
180
160
140
120
100
80
60
40
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

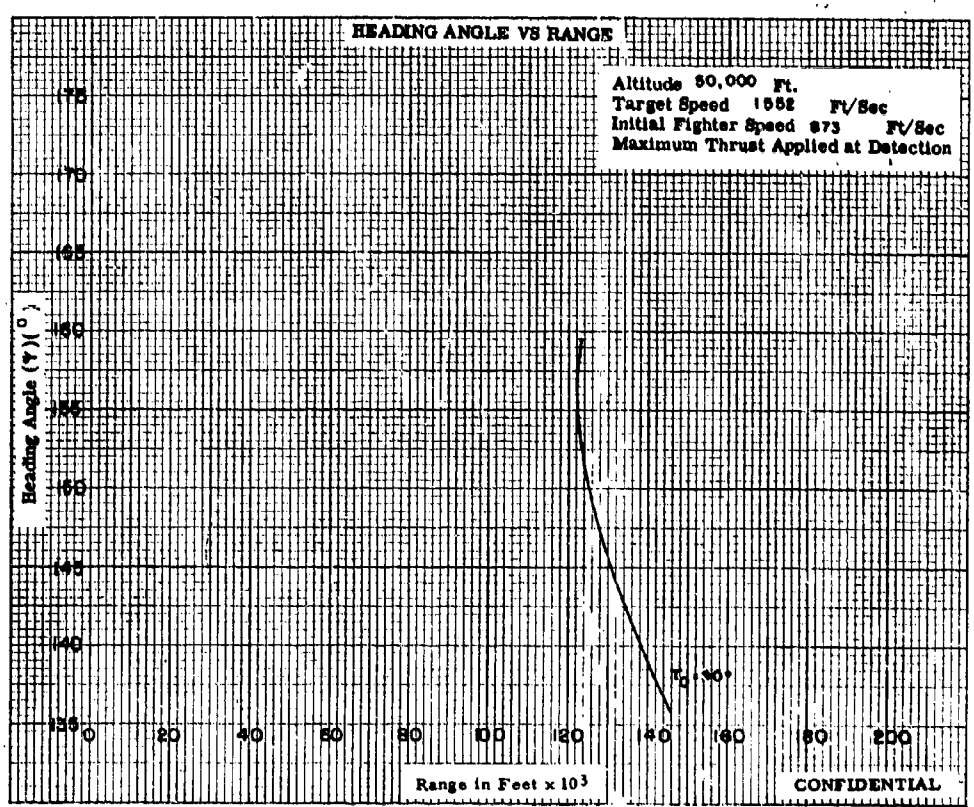

HEADING ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Heading Angle (Ψ)(°)
175
170
165
160
155
150
145
140
135
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-8

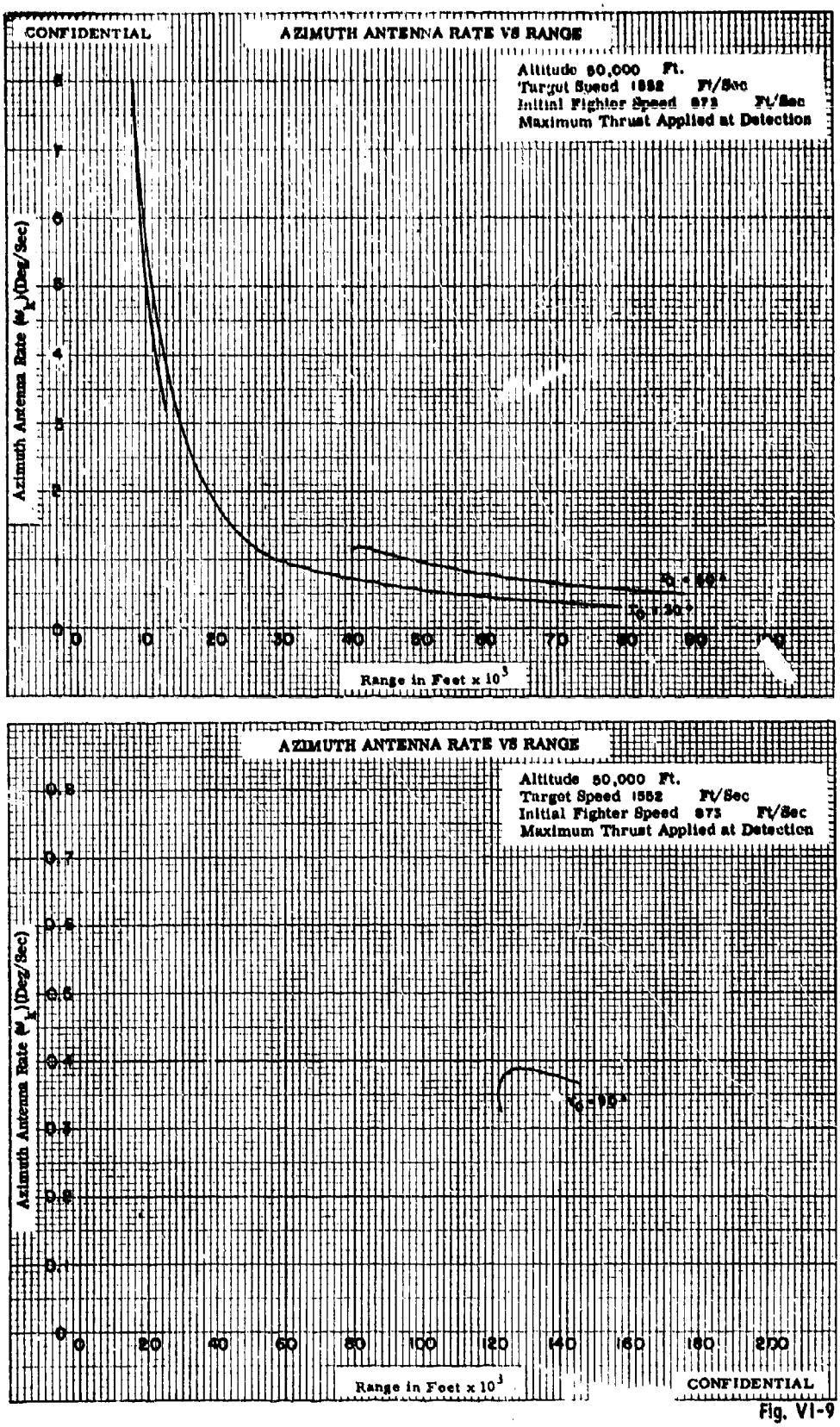
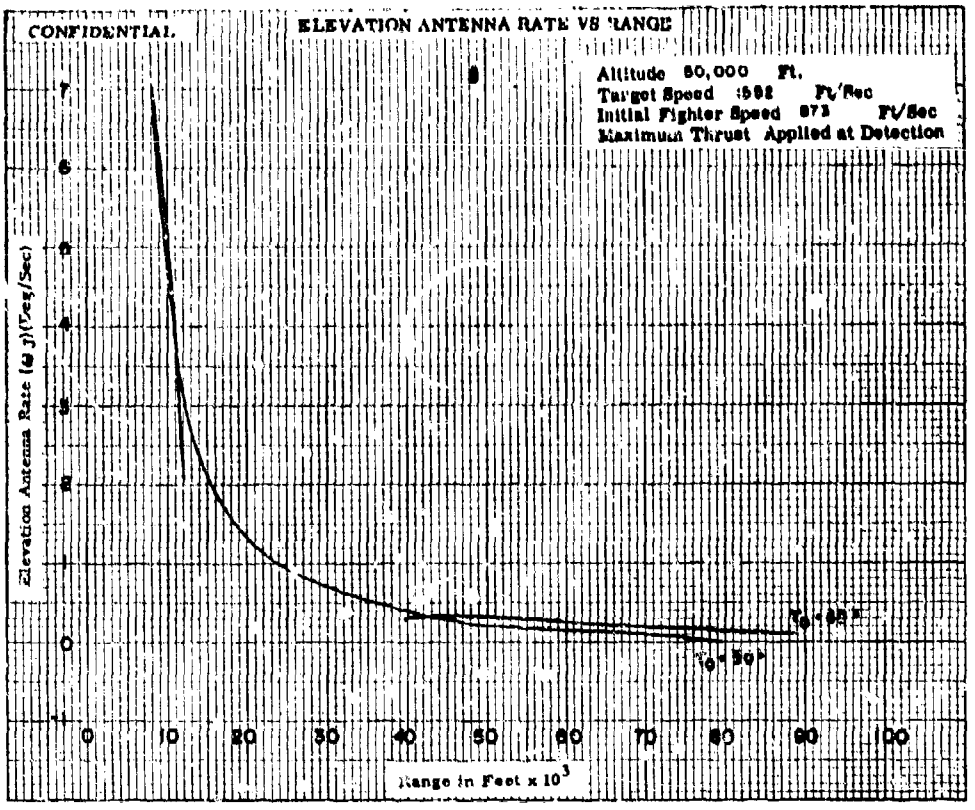

CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Antenna Rate ($\dot{\psi}_A$)(Deg/Sec)
Range in Feet x 10^3
$\psi_0 = 60°$
$\psi_0 = 30°$
0
10
20
30
40
50
60
70
80
90
100
AZIMUTH ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Antenna Rate ($\dot{\psi}_A$)(Deg/Sec)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$\psi_0 = 90°$
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-9


ELEVATION ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate (ω y)(Deg/Sec)
Range in Feet x 10^3
0
10
20
30
40
50
60
70
80
90
100

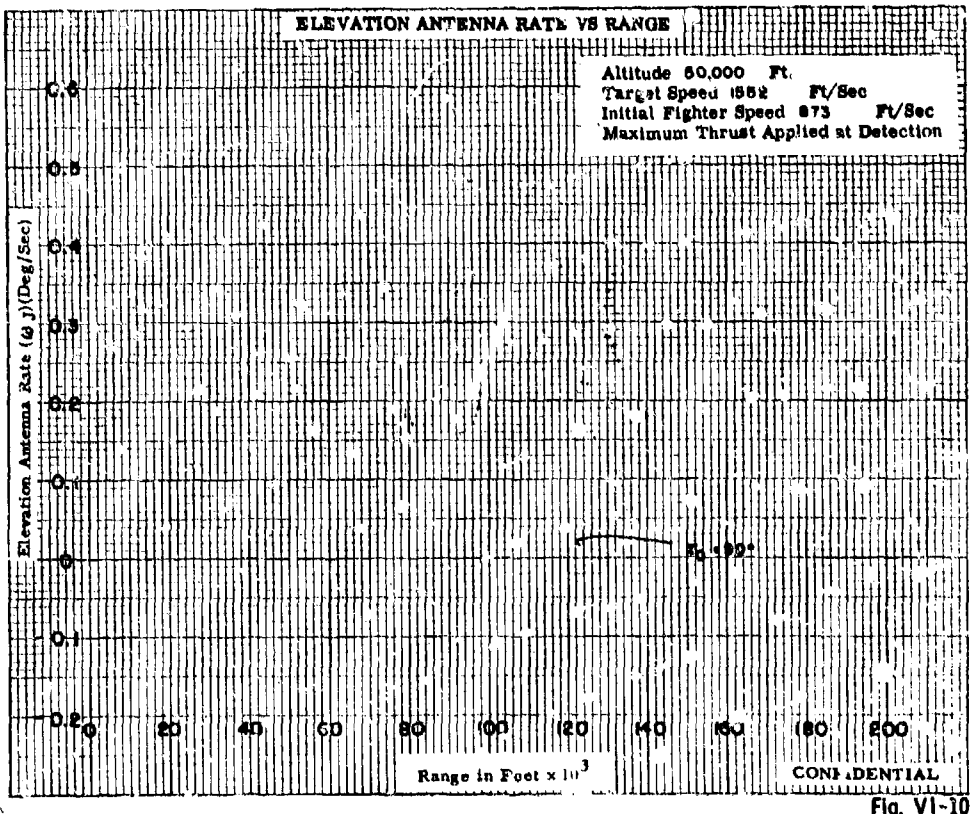
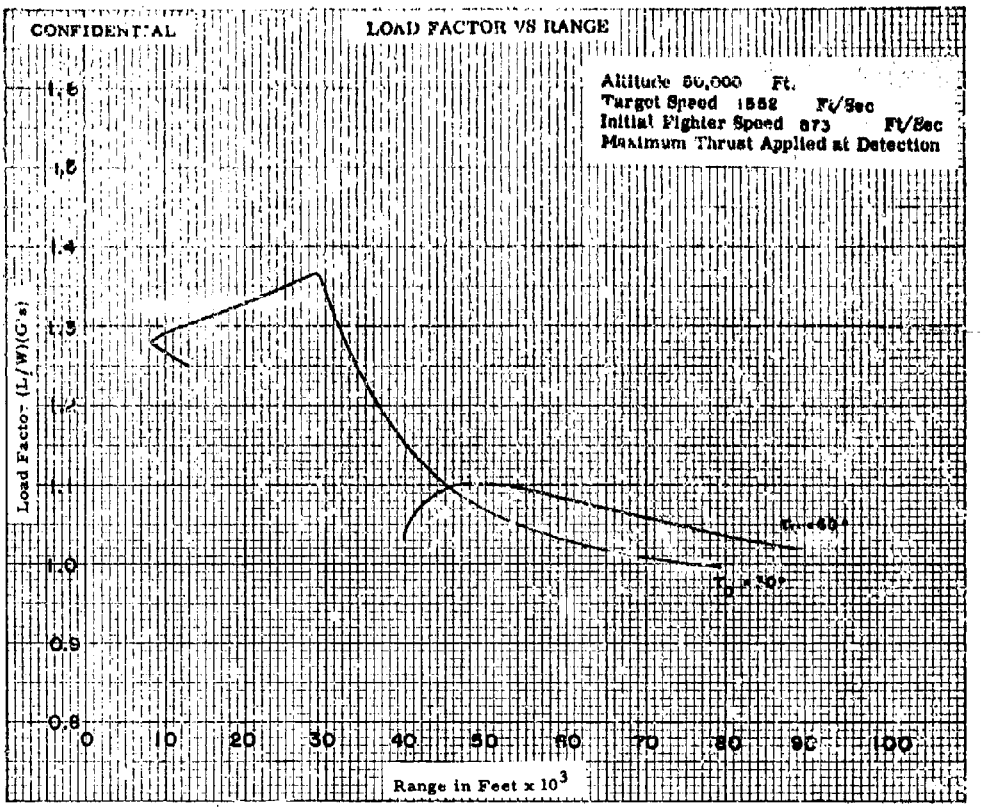

ELEVATION ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate (ω y)(Deg/Sec)
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.2
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-10


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Load Factor (L/W)(G's)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

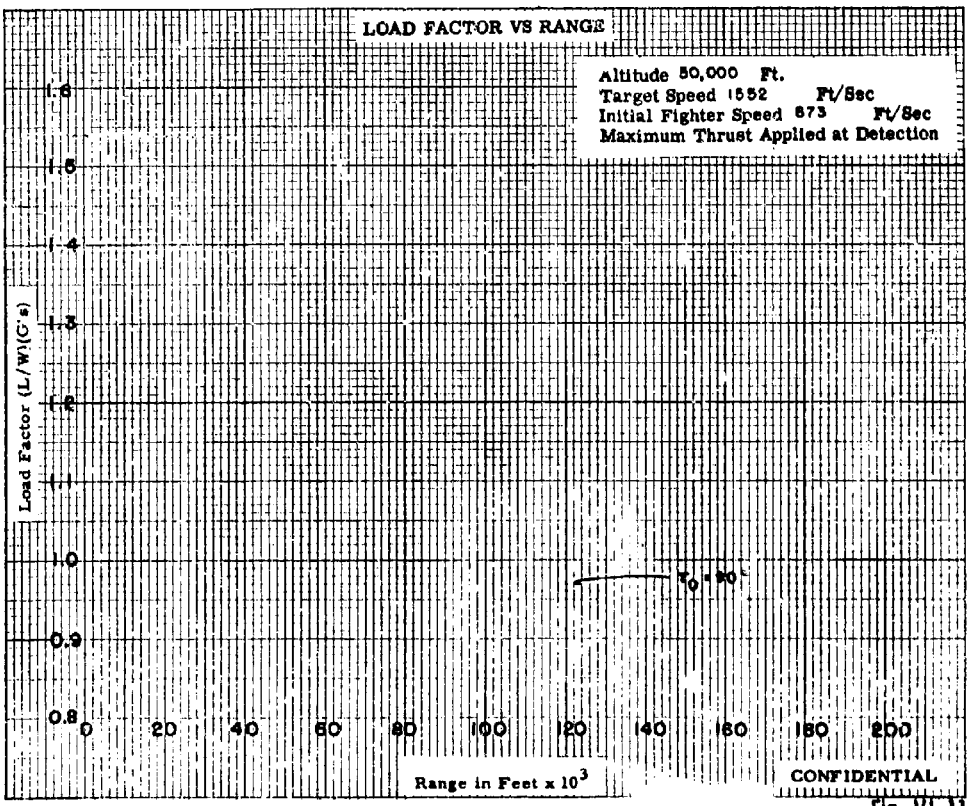
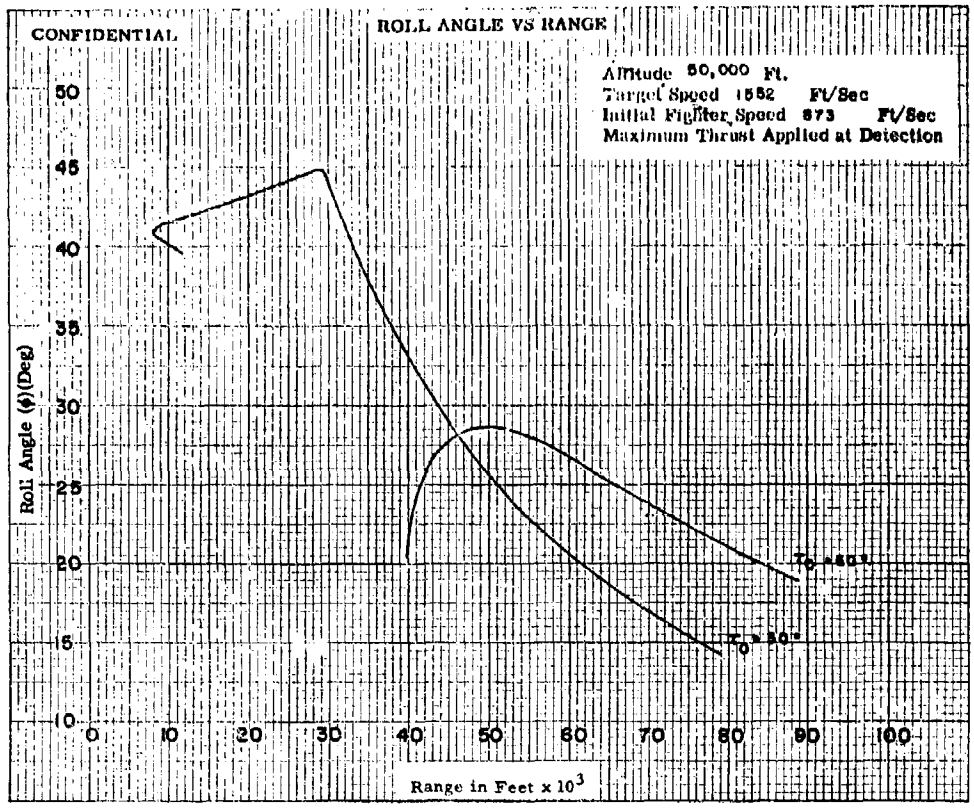

LOAD FACTOR VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Load Factor (L/W)(G's)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-11


CONFIDENTIAL
ROLL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Roll Angle (φ)(Deg)
50
45
40
35
30
25
20
15
10
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

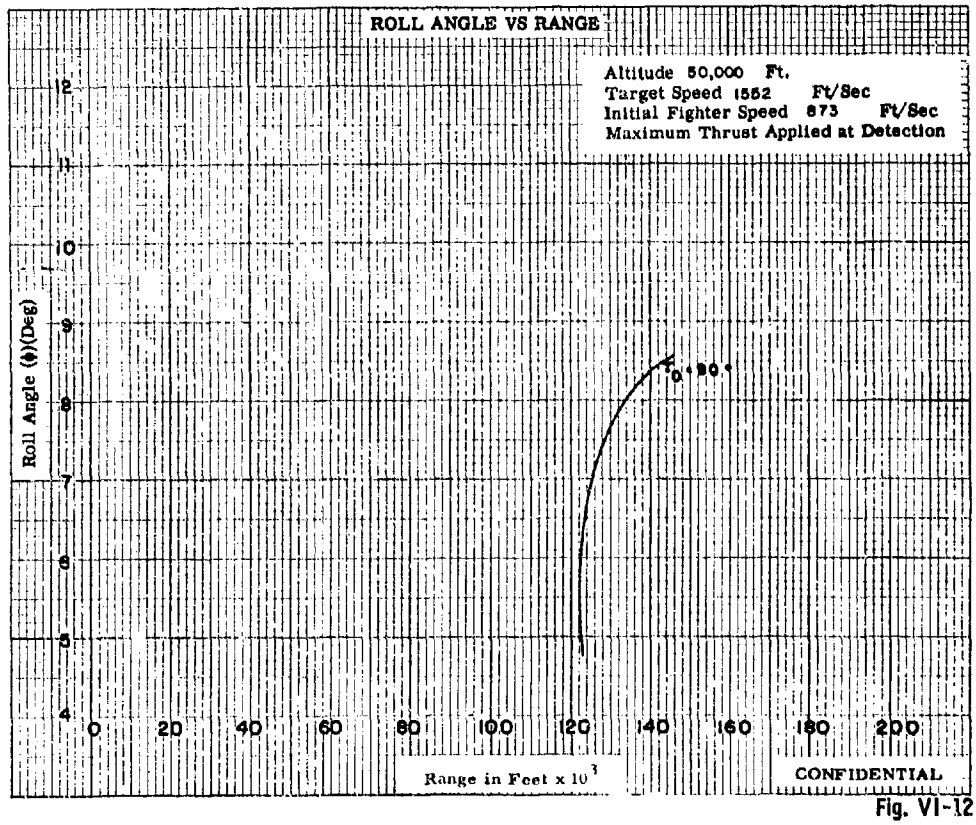
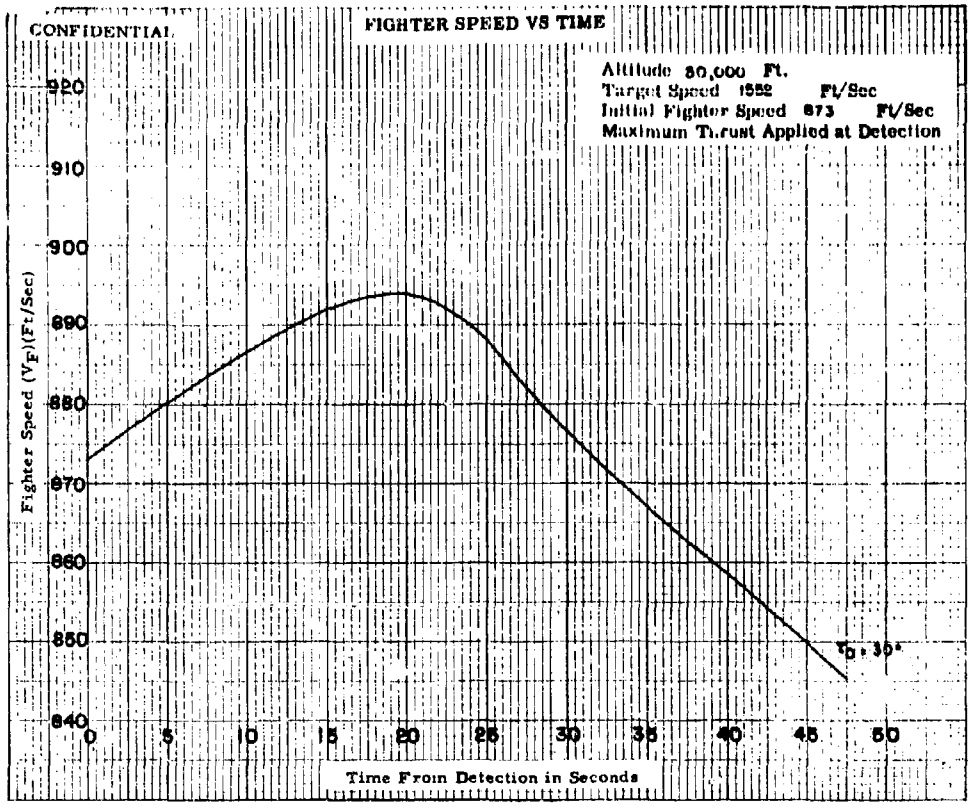

ROLL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Roll Angle (φ)(Deg)
12
11
10
9
8
7
6
5
4
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VI-12


CONFIDENTIAL
FIGHTER SPEED VS TIME
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Fighter Speed (V_F)(Ft/Sec)
920
910
900
890
880
870
860
850
840
0
5
10
15
20
25
30
35
40
45
50
τ_0 = 35°
Time From Detection in Seconds

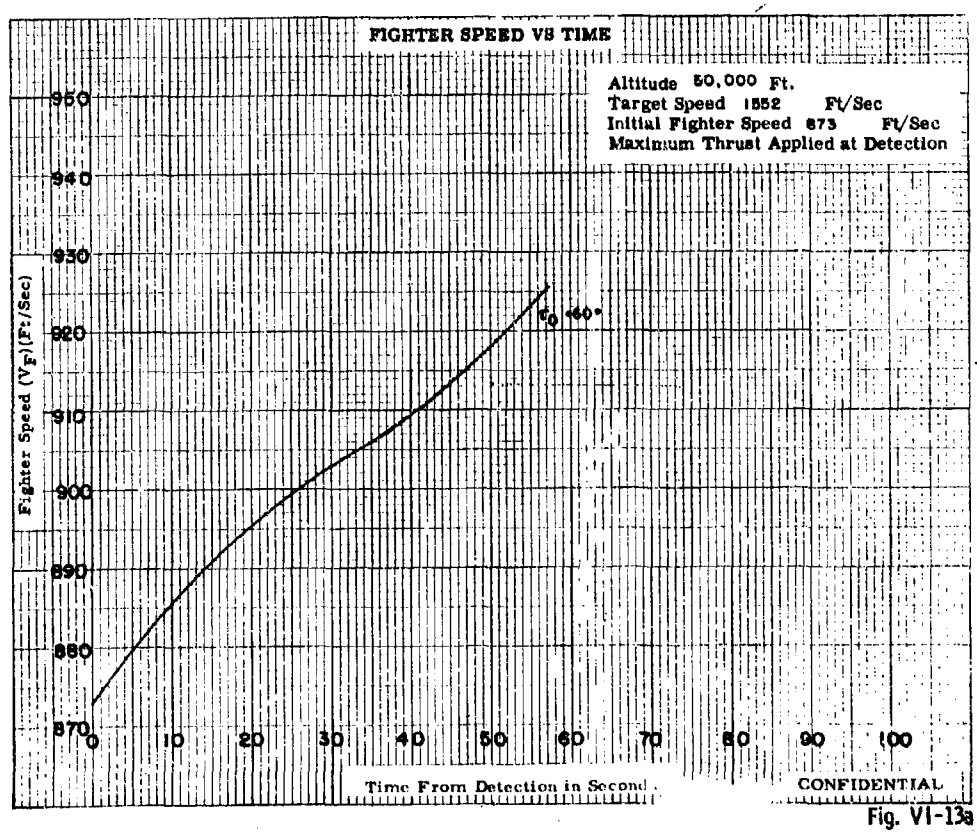

FIGHTER SPEED VS TIME
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Fighter Speed (V_F)(Ft/Sec)
950
940
930
920
910
900
890
880
870
0
10
20
30
40
50
60
70
80
90
100
τ_0 60°
Time From Detection in Second
CONFIDENTIAL

Fig. VI-13a

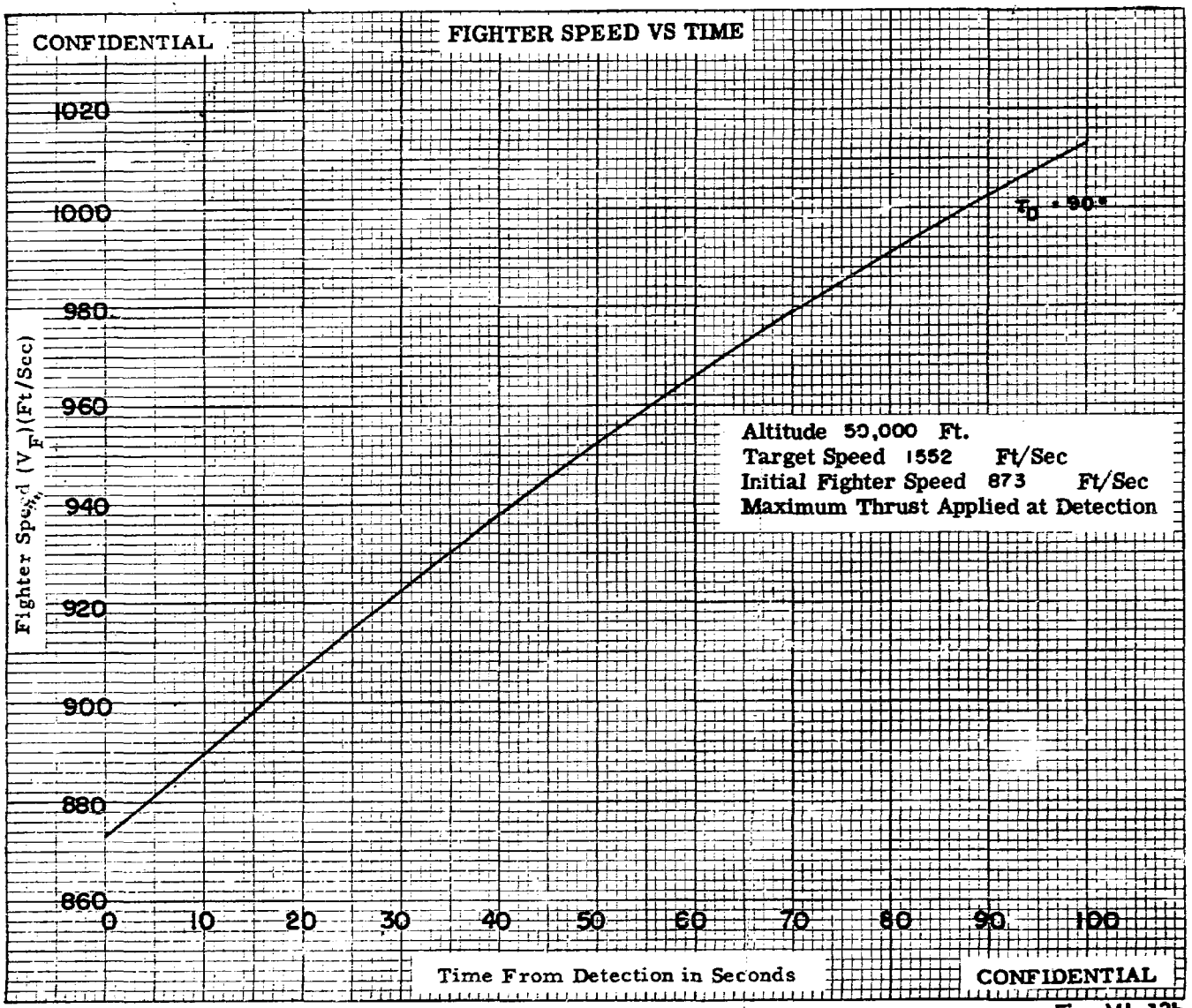
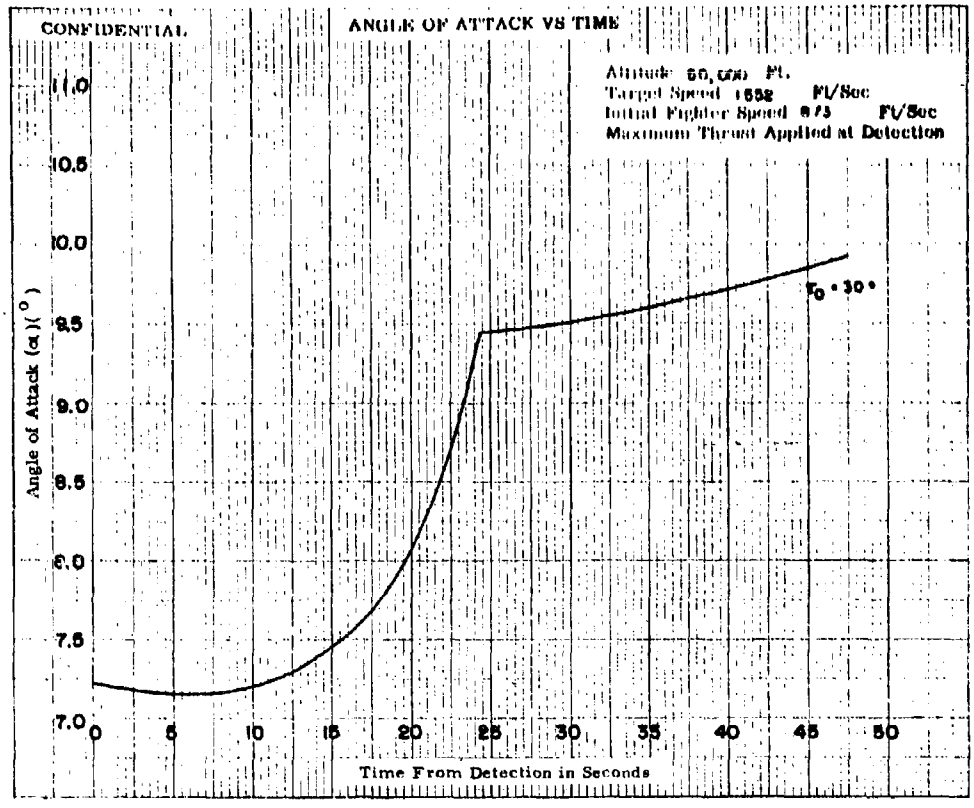

CONFIDENTIAL
FIGHTER SPEED VS TIME
1020
1000
980
960
940
920
900
880
860
Fighter Speed (V_F) (Ft/Sec)
T_D = 90°
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
0
10
20
30
40
50
60
70
80
90
100
Time From Detection in Seconds
CONFIDENTIAL

Fig. VI-13b


ANGLE OF ATTACK VS TIME
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Angle of Attack (α)(°)
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
0
5
10
15
20
25
30
35
40
45
50
T_D = 30°
Time From Detection in Seconds

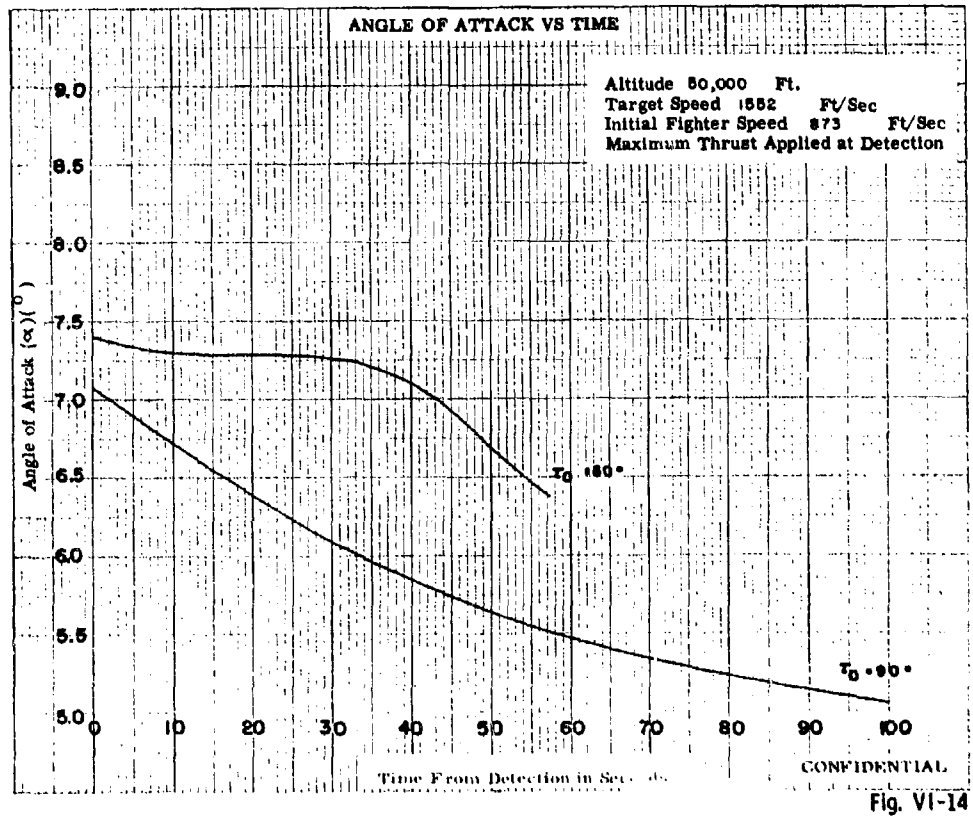
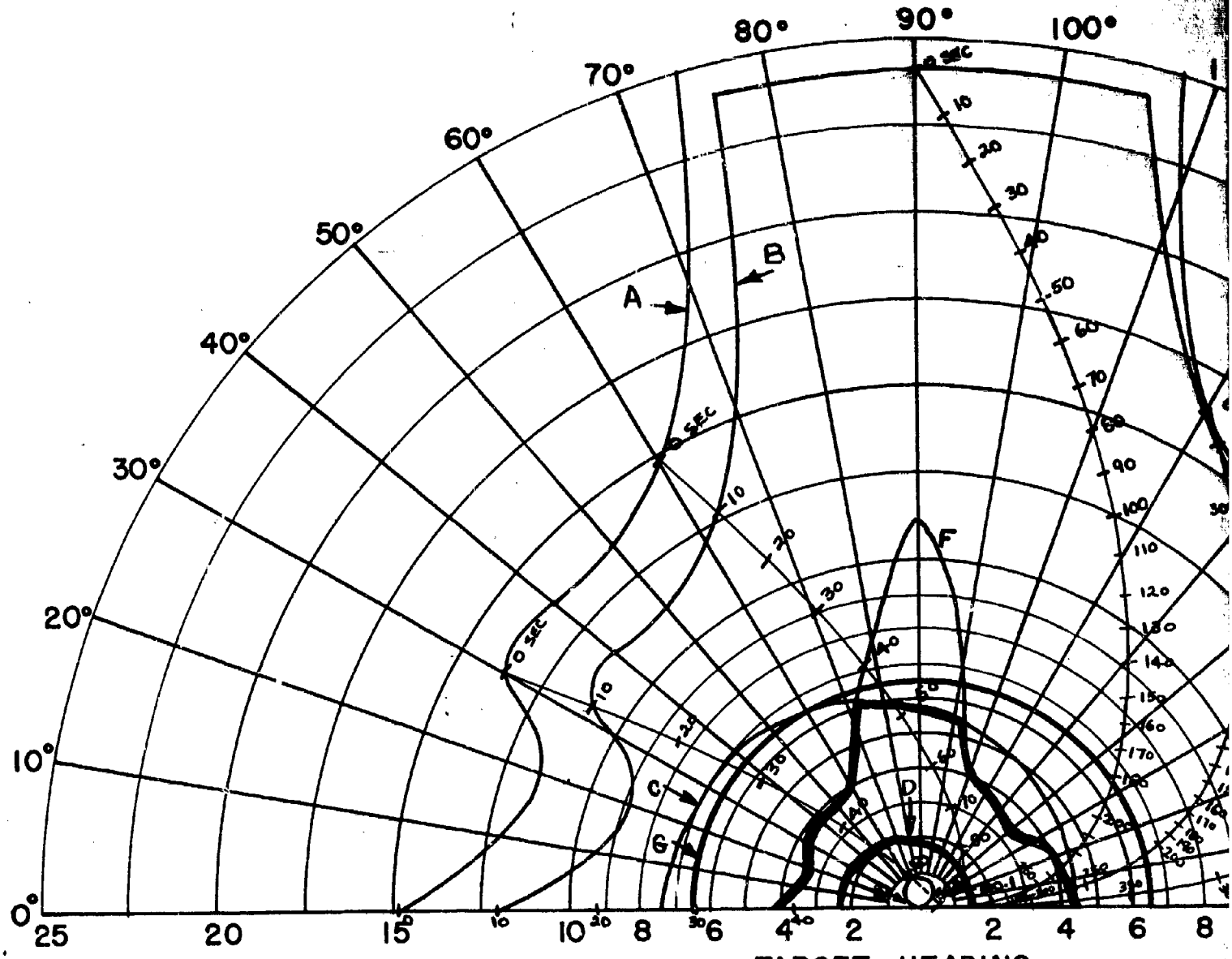

ANGLE OF ATTACK VS TIME
Altitude 50,000 Ft.
Target Speed 1552 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Angle of Attack (α)(°)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
0
10
20
30
40
50
60
70
80
90
100
T_D = 60°
T_D = 90°
Time From Detection in Seconds

Fig. VI-14



← TARGET HEADING

V_F = 873 FT/SEC (F4H-1)(F8U-3)

V_T = 873 FT/SEC

ALTITUDE = 50,000 FT.

INCREASED THRUST AT DETECTION

A - 85% DETECTION RANGE

B - LOCK-ON RANGE (10 SEC. LOCK-ON TIM

C - SPARROW III MAX. AERODYNAMIC RAN

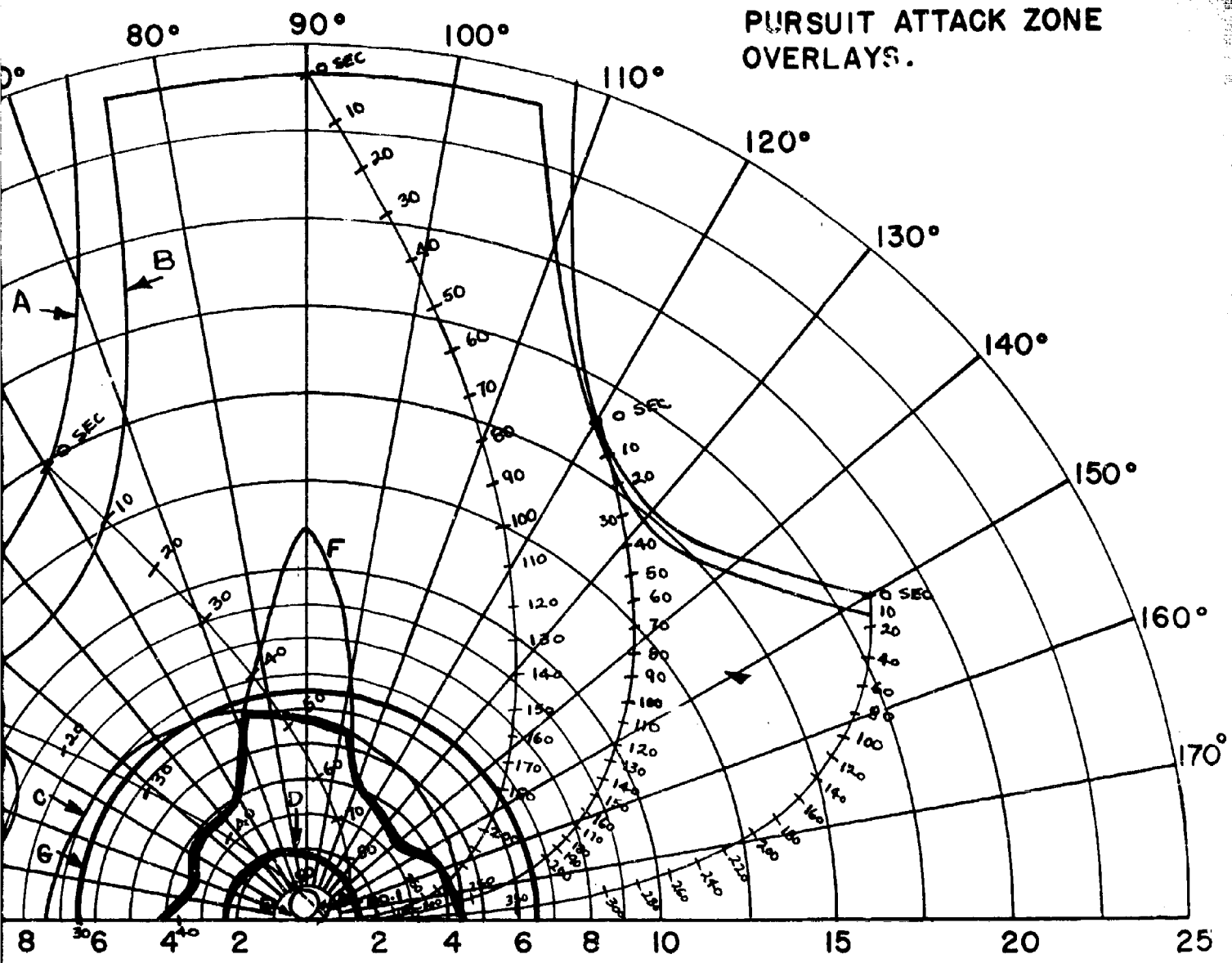
D - SPARROW III MIN. AERODYNAMIC RAN

E - CONSTANT LOAD FACTOR LOCUS (N_z

F - 90% SPARROW III SEEKER LOCK-ON

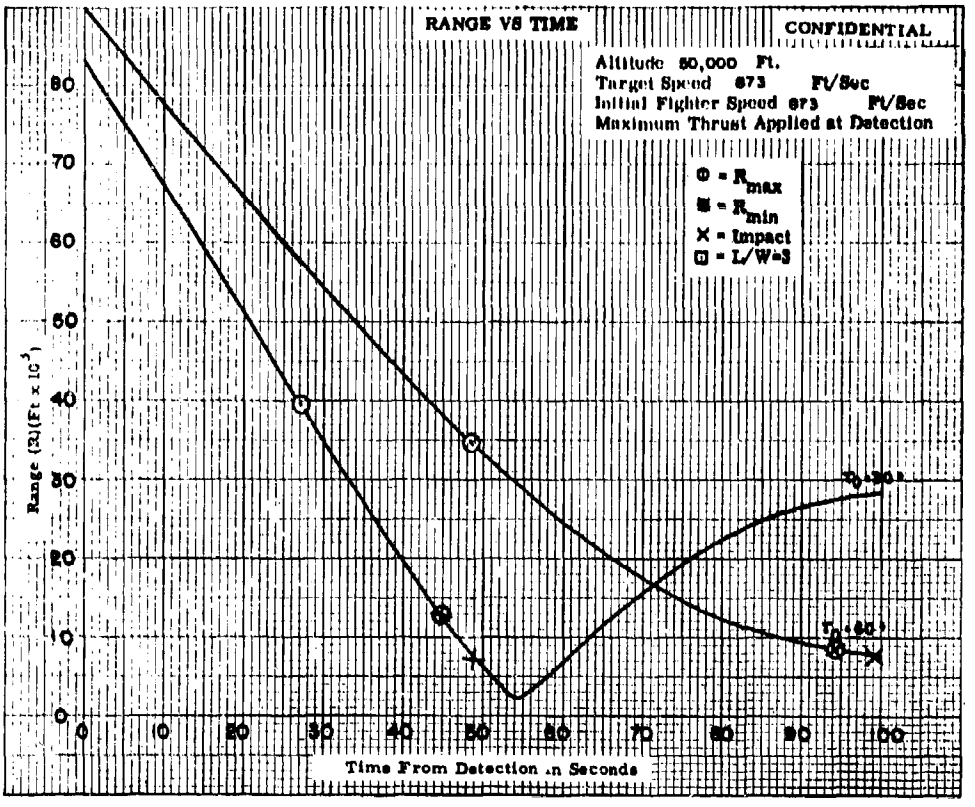
G - 6.5 N.M. INTERLOCK

FIG. VII - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS.



85% DETECTION RANGE
LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
SPARROW III MAX. AERODYNAMIC RANGE
SPARROW III MIN. AERODYNAMIC RANGE
CONSTANT LOAD FACTOR LOCUS ($N_z = 3$)
90% SPARROW III SEEKER LOCK-ON RANGE
6.5 N.M. INTERLOCK

CONFIDENTIAL


RANGE VS TIME
CONFIDENTIAL
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
⊙ = R_{max}
■ = R_{min}
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10^3)
Time From Detection in Seconds
τ_0=30°
τ_0=60°

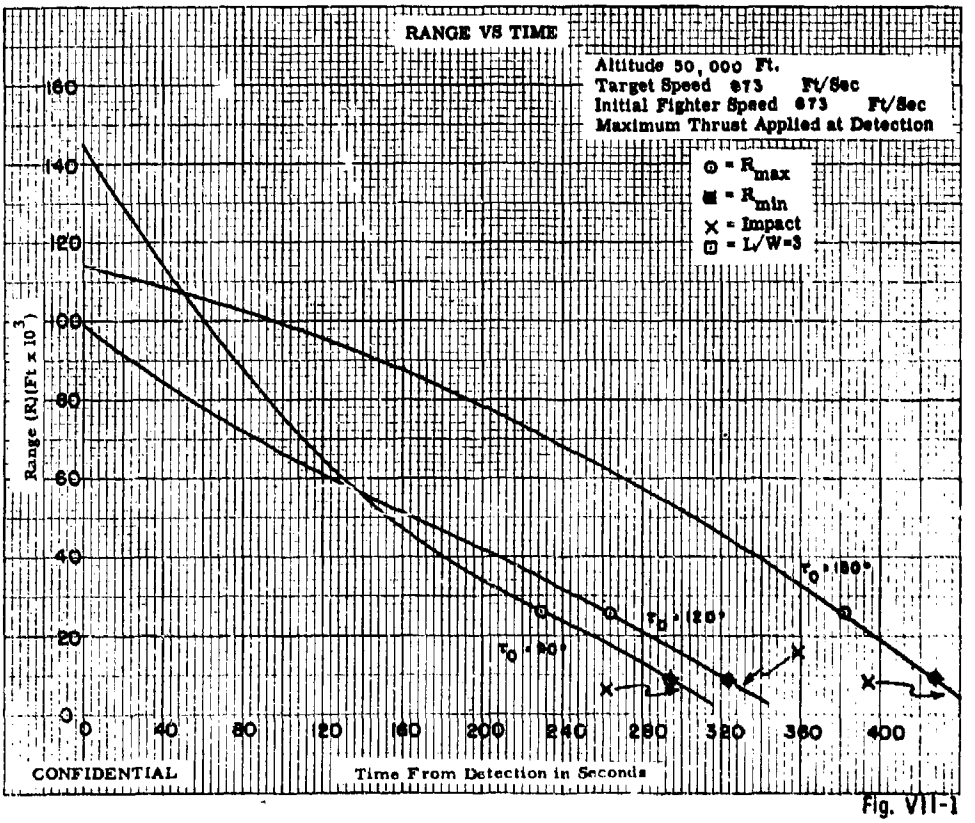
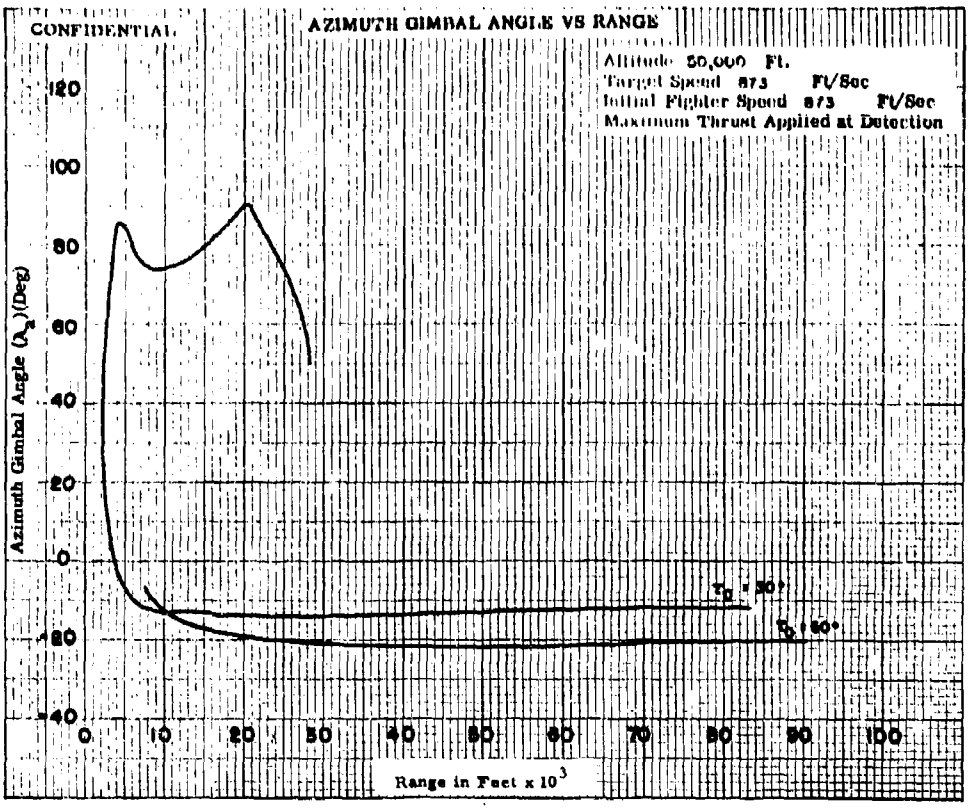

RANGE VS TIME
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
⊙ = R_{max}
■ = R_{min}
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10^3)
Time From Detection in Seconds
τ_0=30°
τ_0=120°
τ_0=180°
CONFIDENTIAL

Fig. VII-1


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (λ_2)(Deg)
120
100
80
60
40
20
0
-20
-40
τ_0 = 30°
τ_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

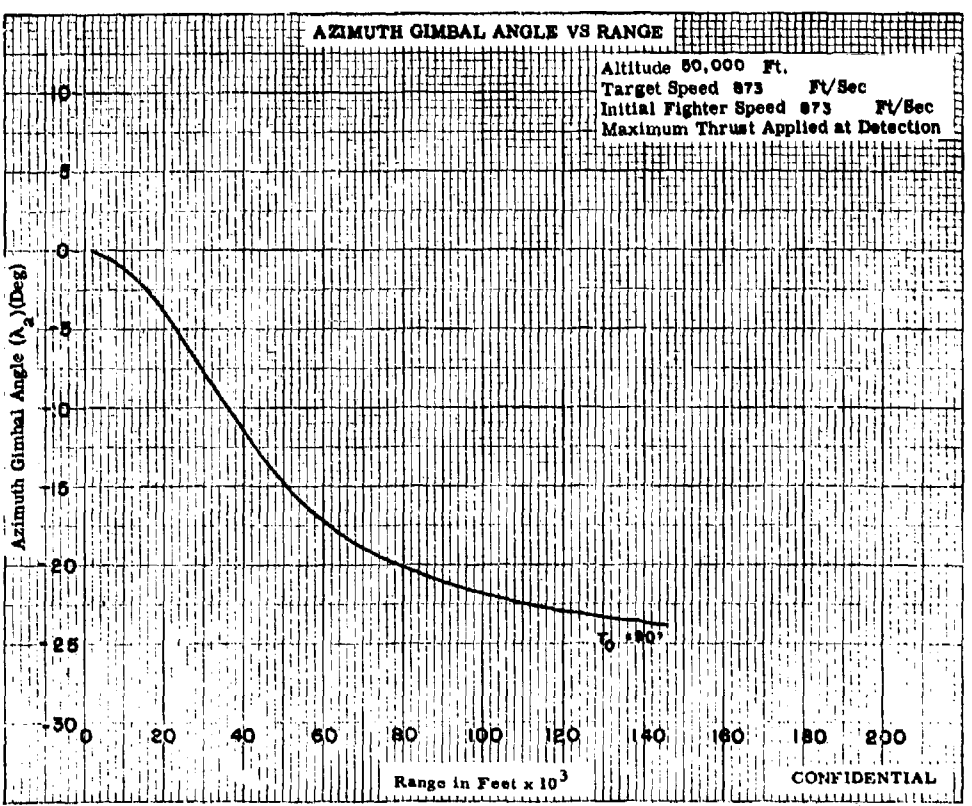
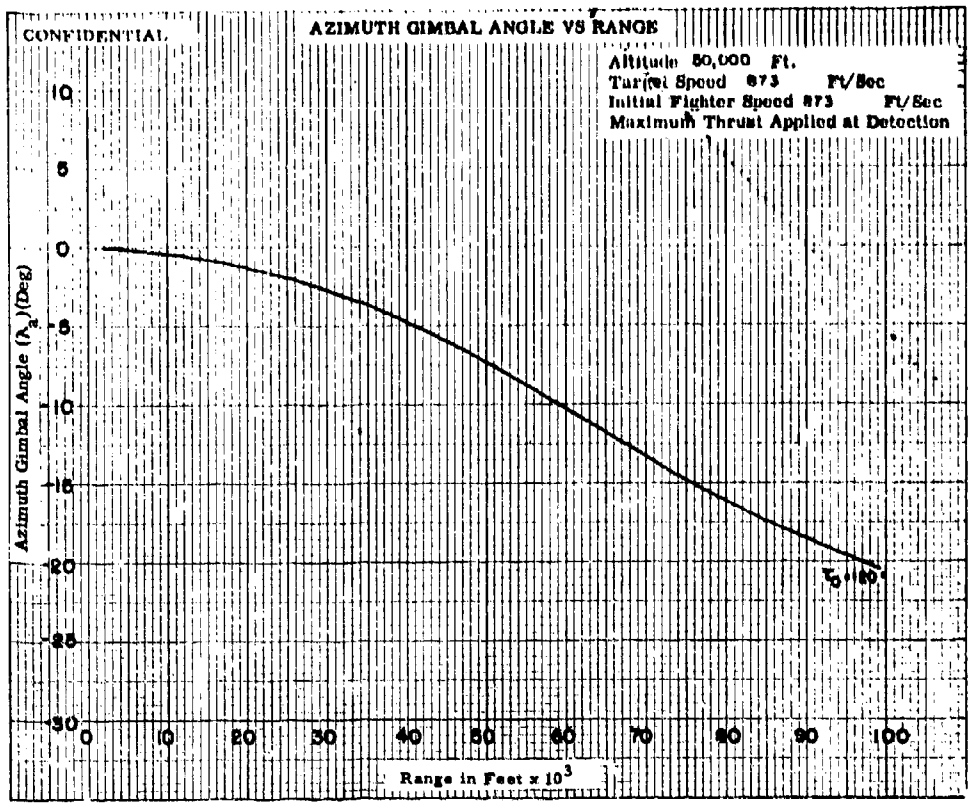

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (λ_2)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
τ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-2a


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (λ_2)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
T_0 = 180°

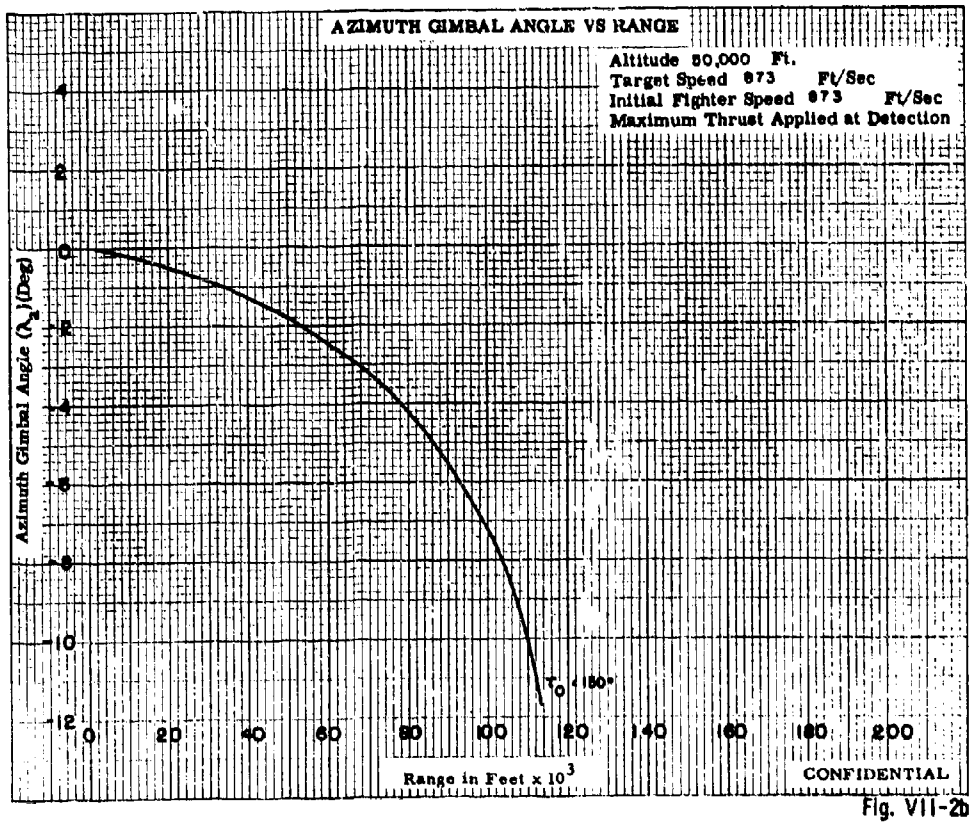
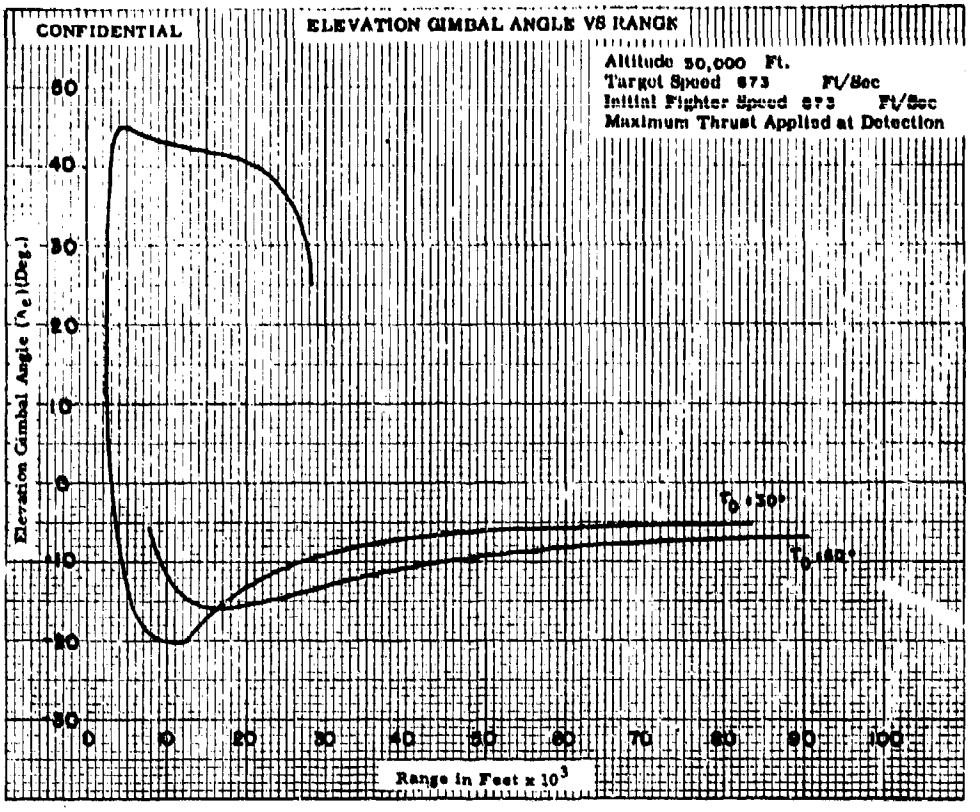

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (λ_2)(Deg)
4
2
0
-2
-4
-6
-8
-10
-12
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
T_0 = 180°
CONFIDENTIAL

Fig. VII-2b


ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Gimbal Angle (λ_E)(Deg.)
60
40
30
20
10
0
-10
-20
-30
T_D +30°
T_D +180°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

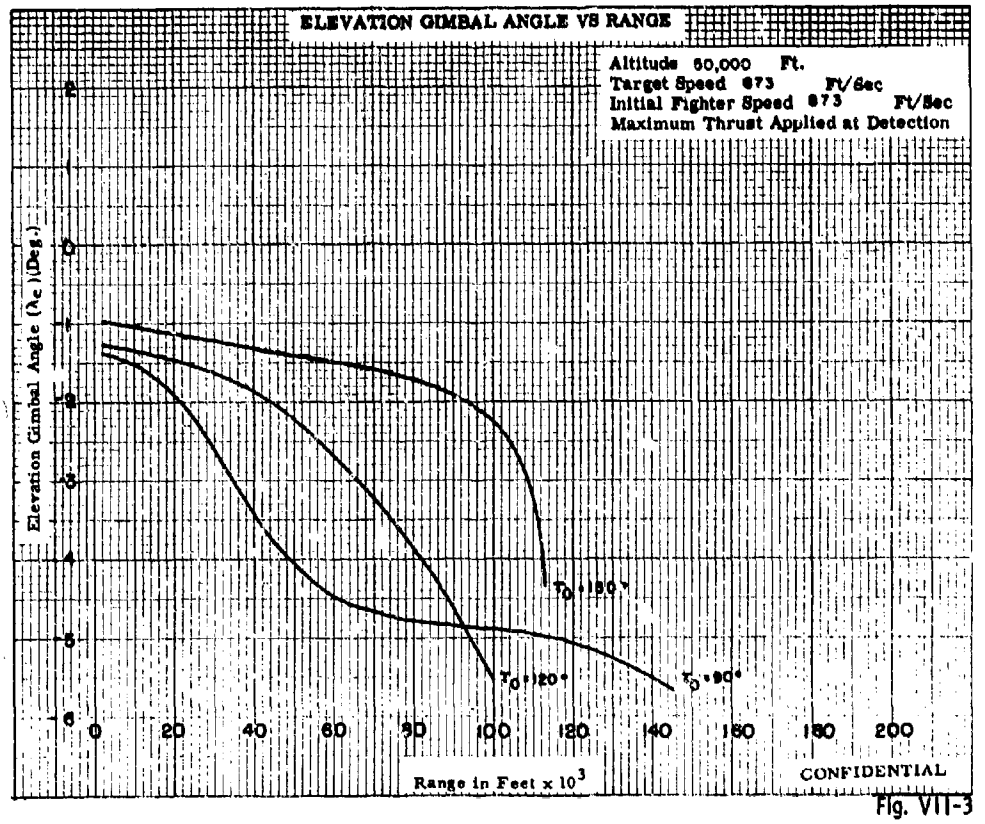
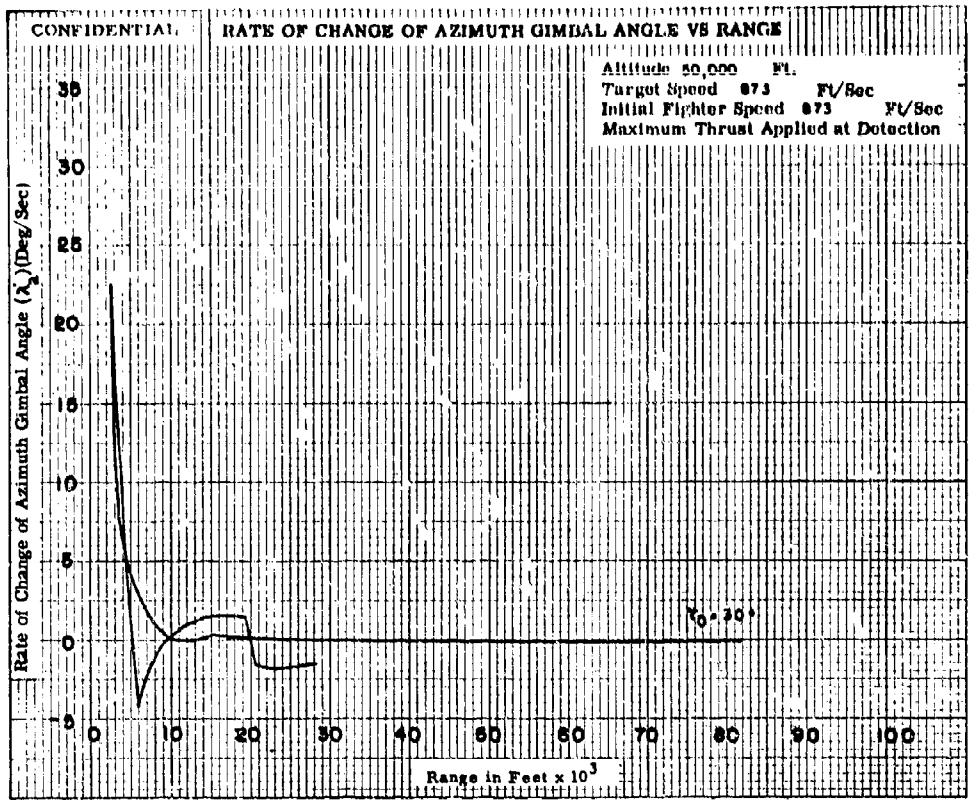

ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Gimbal Angle (λ_E)(Deg.)
2
1
0
-1
-2
-3
-4
-5
-6
T_D +150°
T_D +120°
T_D +90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

Fig. VII-3


RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
35
30
25
20
15
10
5
0
-5
$\gamma_0 = 30°$
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

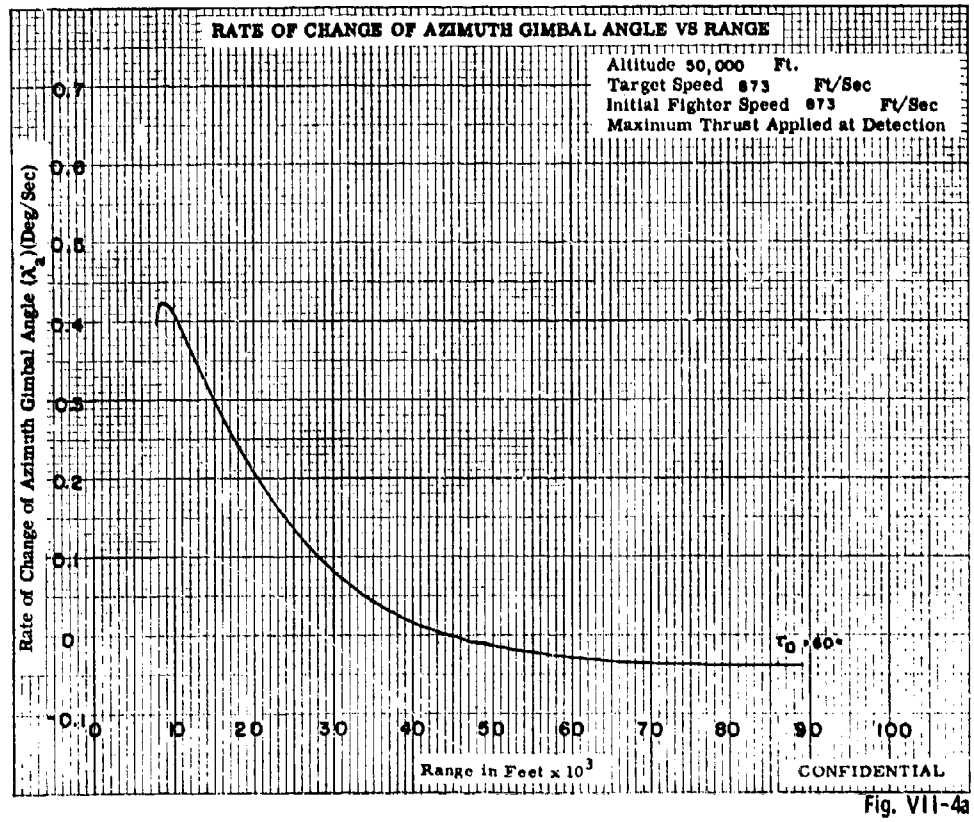

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
$\gamma_0 = 60°$
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-4a

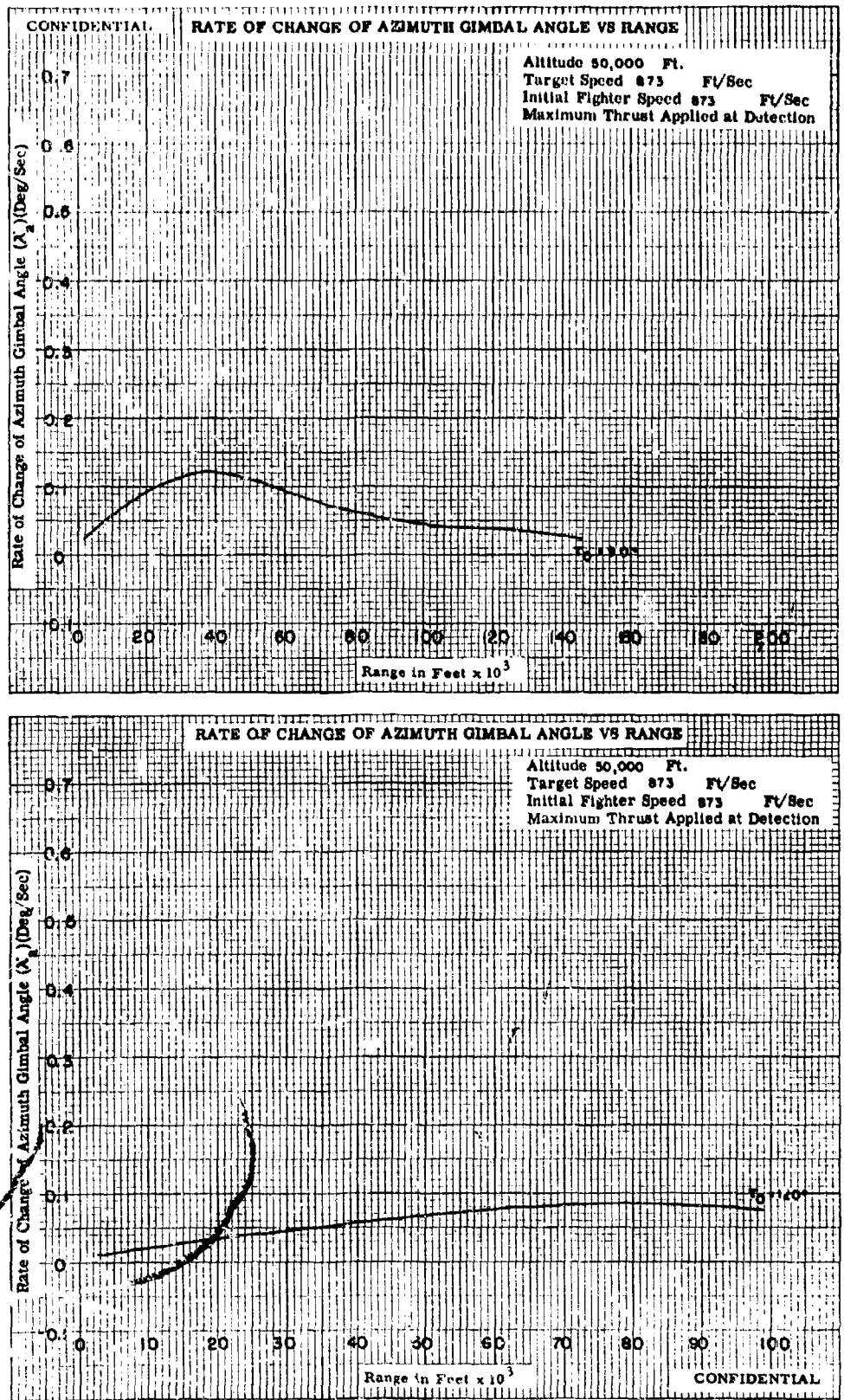

CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle (λ_a)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
20
40
60
80
100
120
140
160
180
200
T_D 13.0°
Range in Feet x 10^3
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle (λ_a)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
10
20
30
40
50
60
70
80
90
100
T_D 7.40°
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-4b

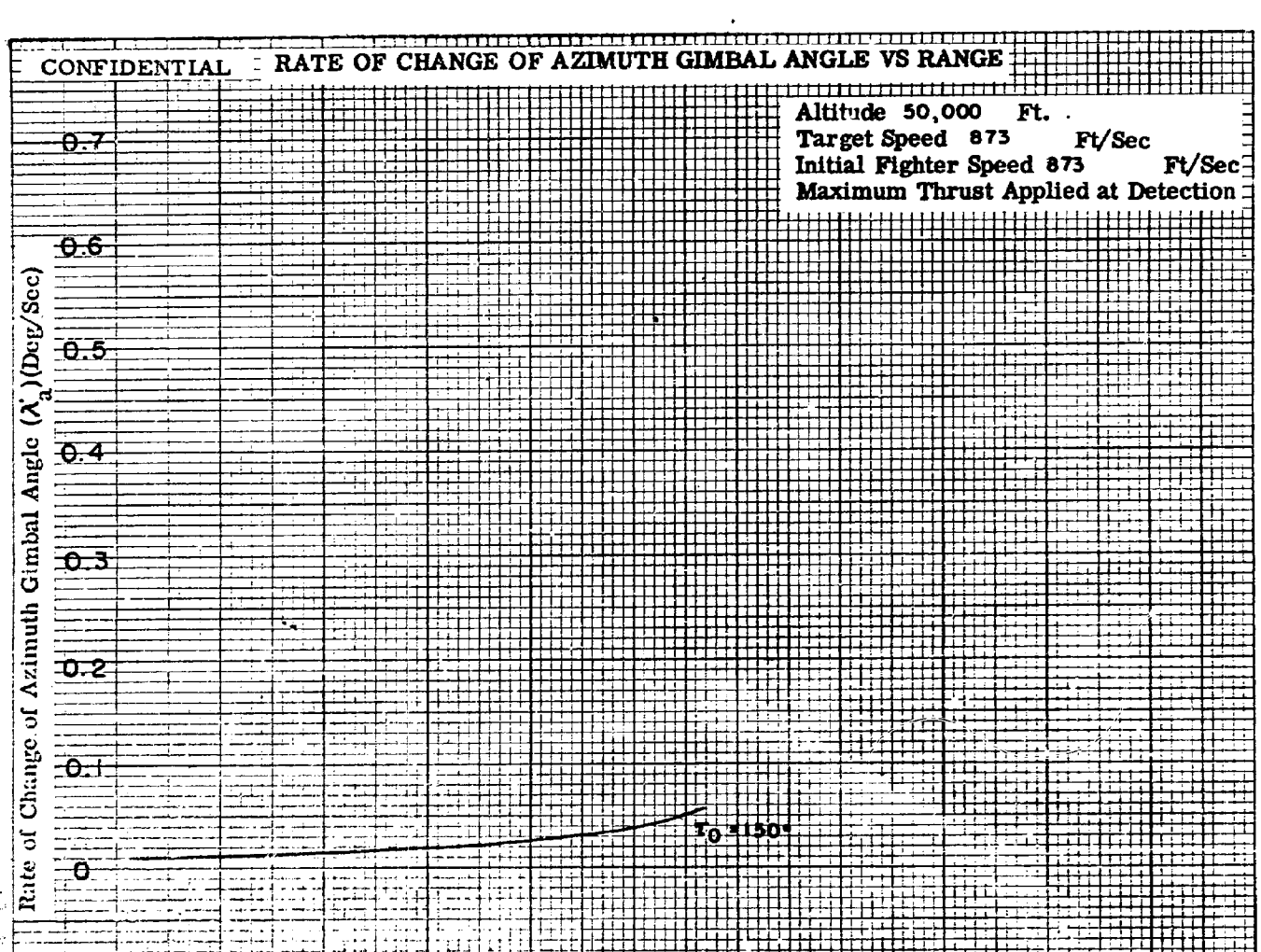
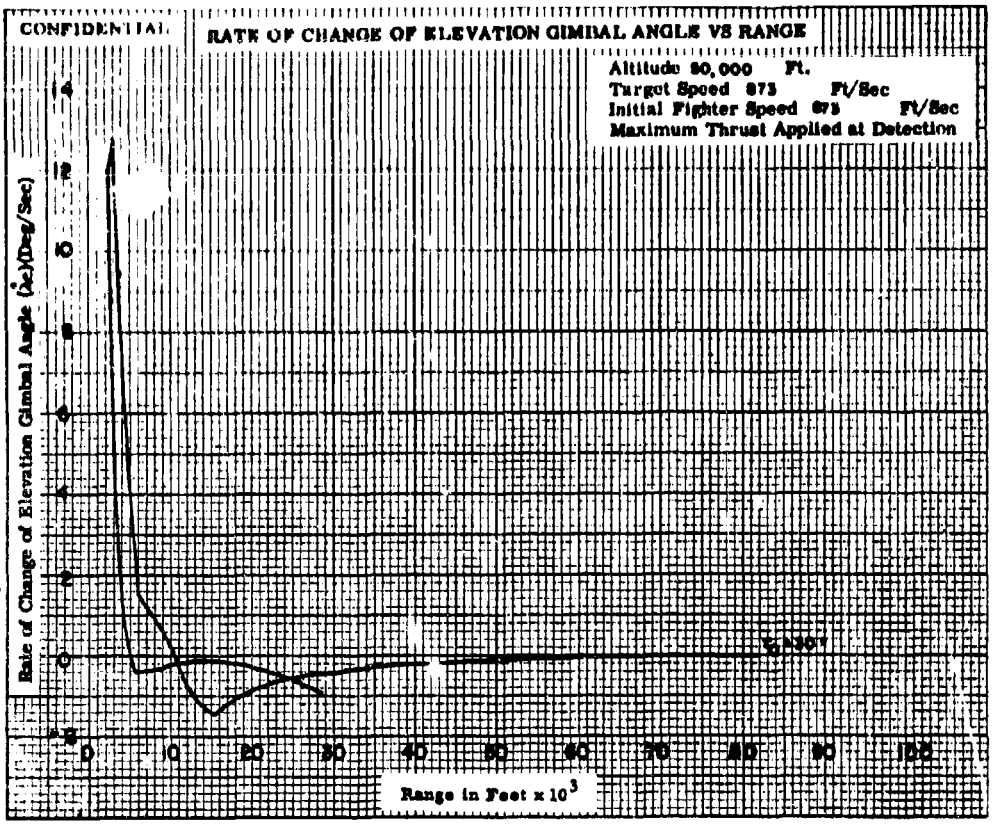

CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle (λ_a)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
T_0 =150°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-4c


CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle ($\dot{\lambda}_E$)(Deg/Sec)
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
70
80
90
100
θ_E=30°
Range in Feet x 10^3

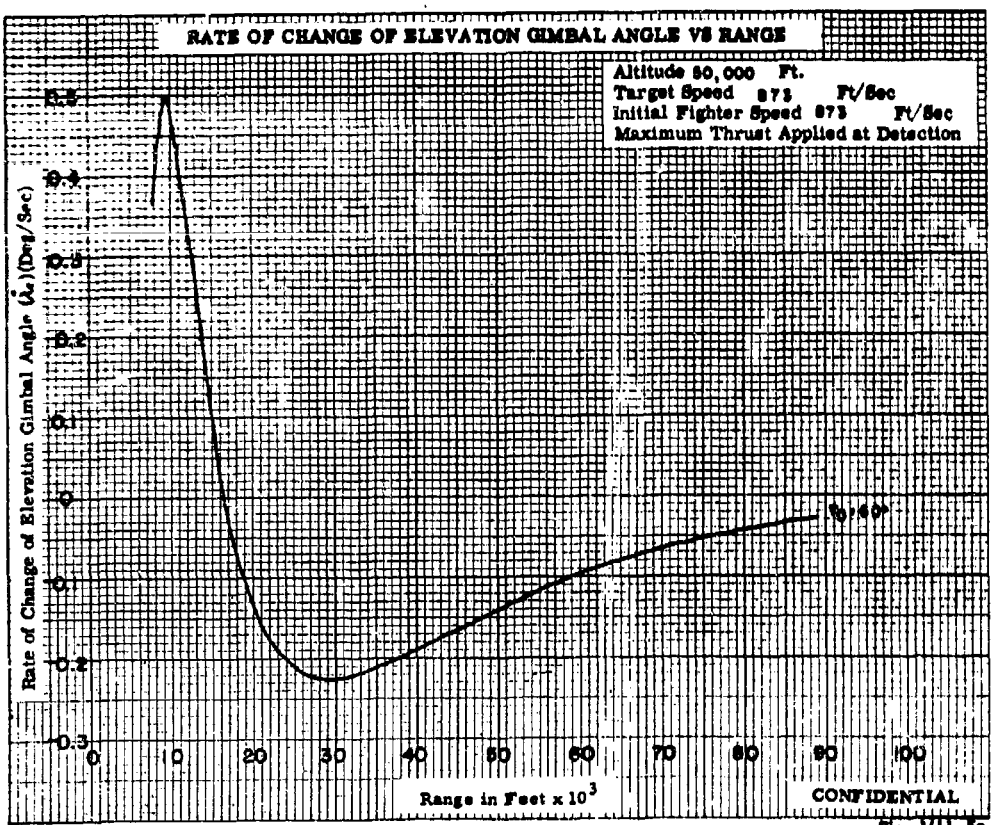
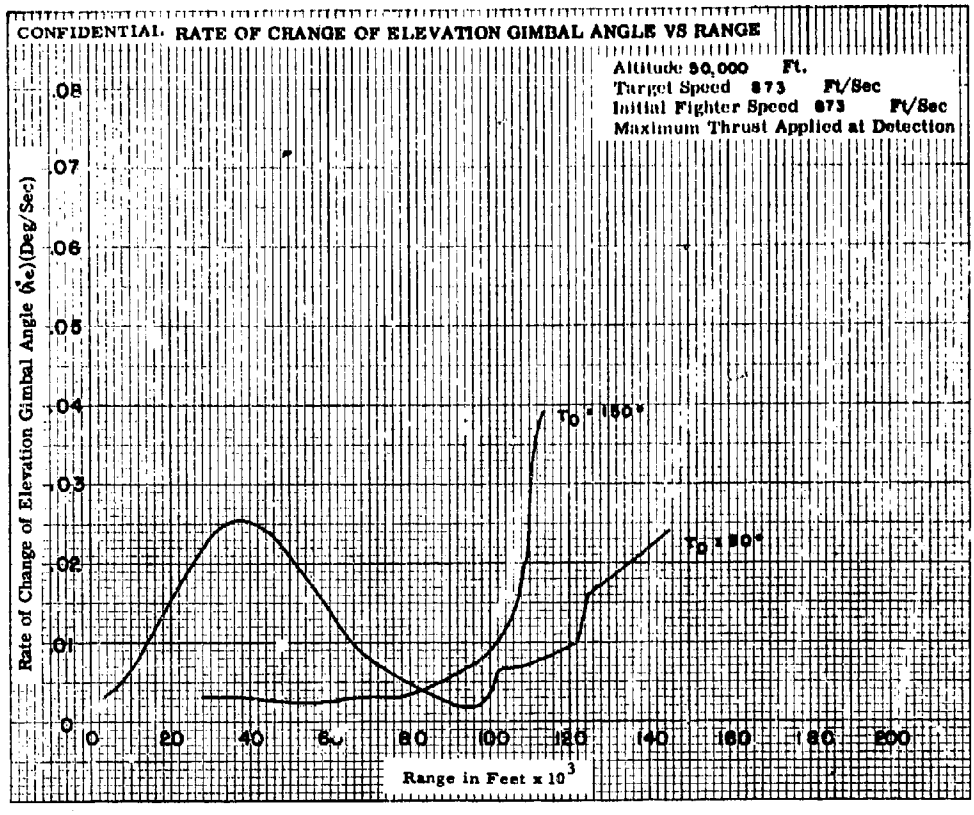

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle ($\dot{\lambda}_E$)(Deg/Sec)
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
10
20
30
40
50
60
70
80
90
100
θ_E=60°
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-5a


CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
.08
.07
.06
.05
.04
.03
.02
.01
0
0
20
40
60
80
100
120
140
160
180
200
T_D = 150°
T_D = 90°
Range in Feet x 10^3

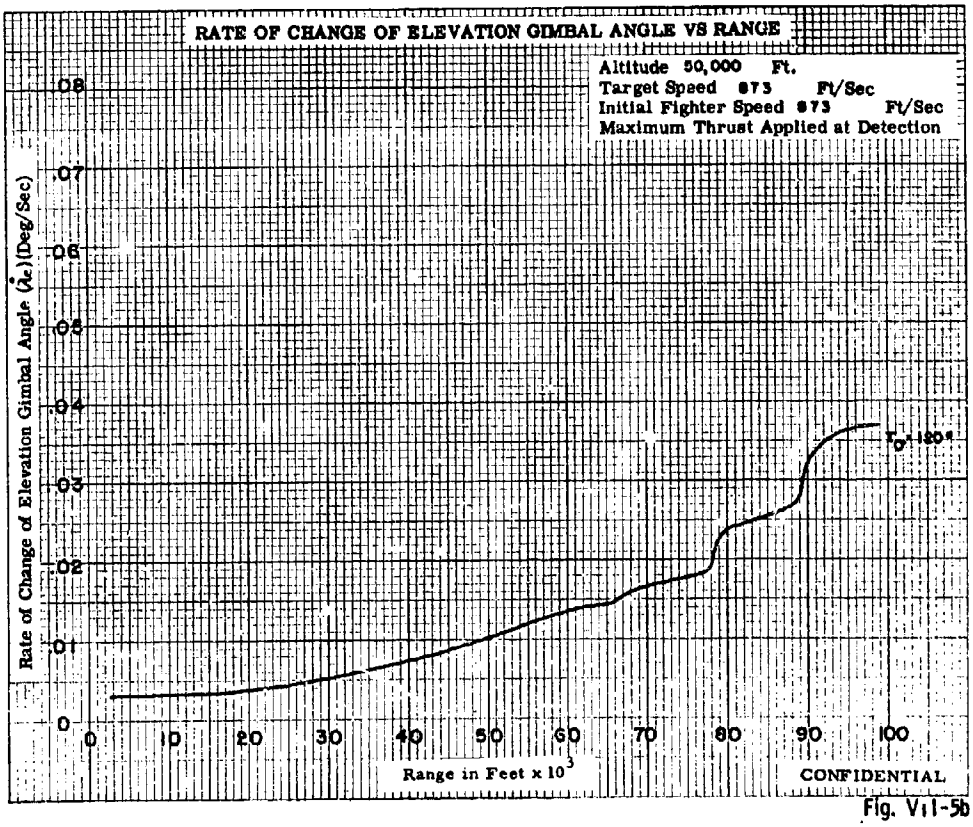
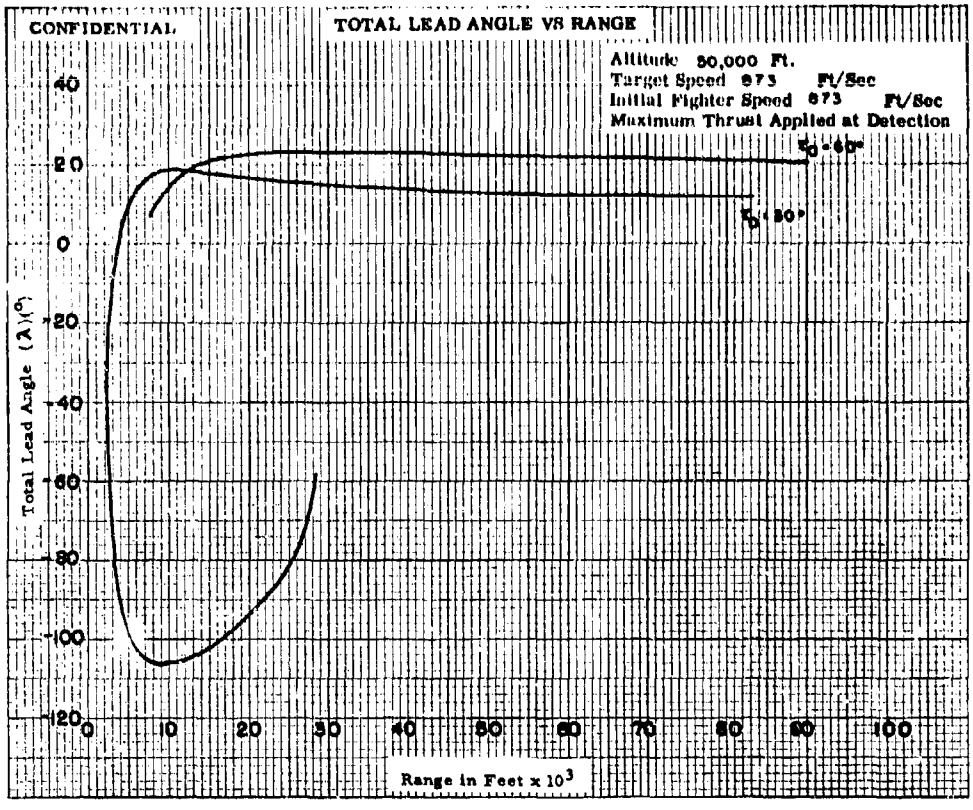

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
.08
.07
.06
.05
.04
.03
.02
.01
0
0
10
20
30
40
50
60
70
80
90
100
T_D = 120°
Range in Feet x 10^3
CONFIDENTIAL

Fig. V11-5b


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
ψ_D = 60°
ψ_D = 30°
Total Lead Angle (λ)(°)
40
20
0
-20
-40
-60
-80
-100
-120
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

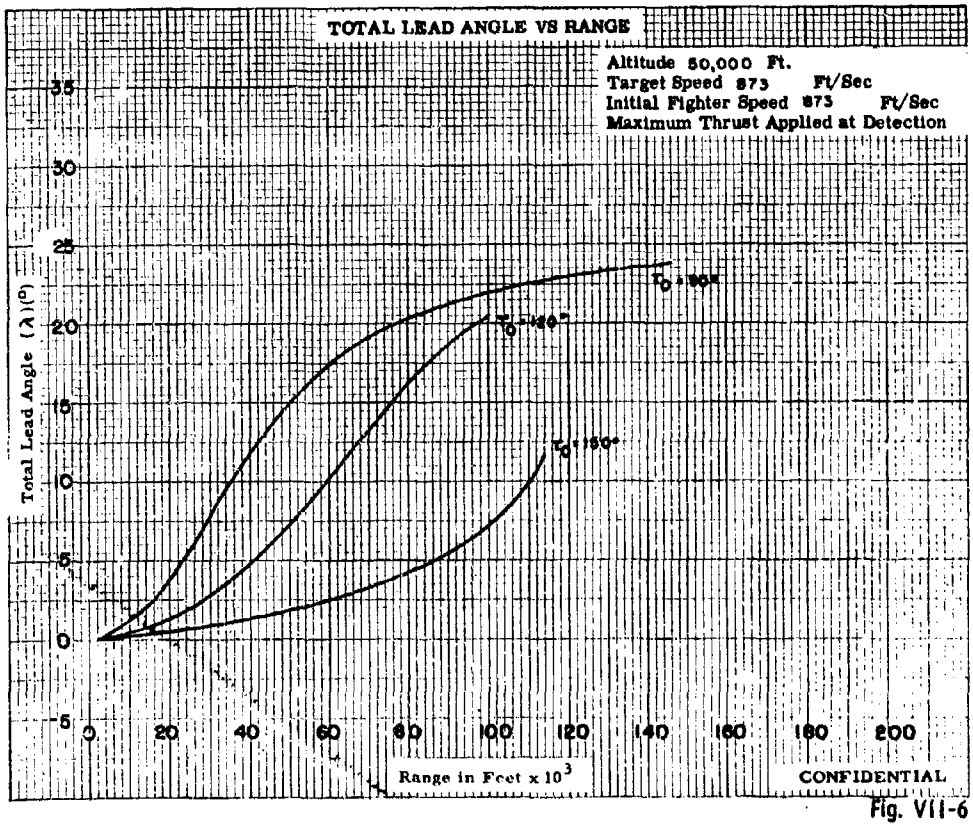
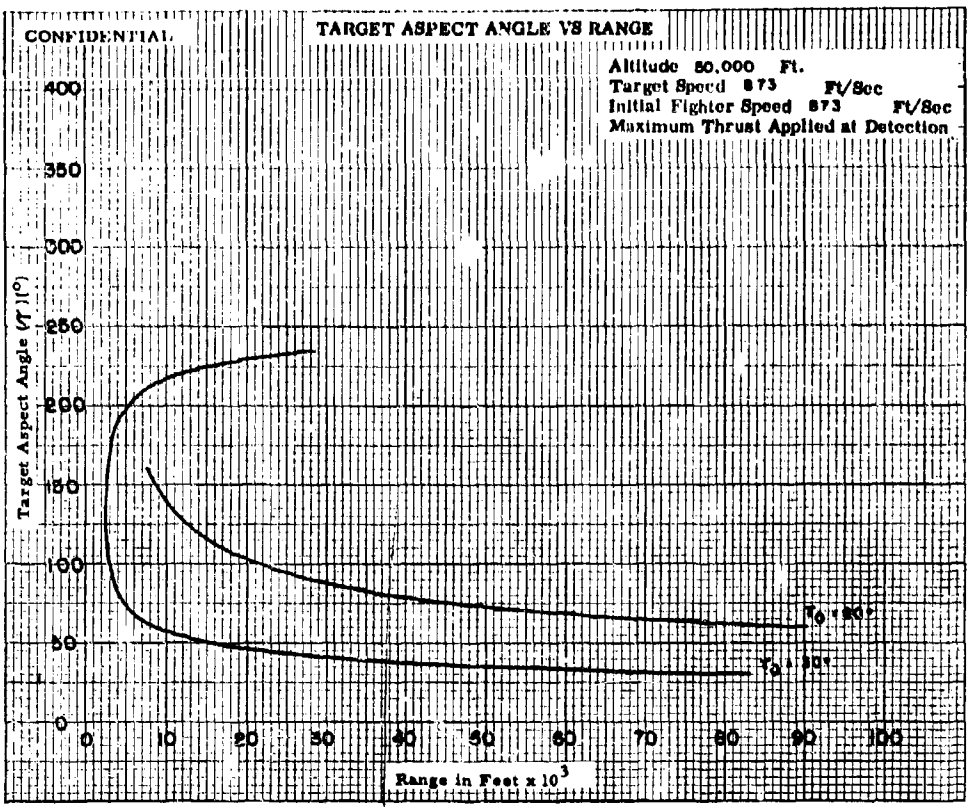

TOTAL LEAD ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
ψ_D = 90°
ψ_D = 60°
ψ_D = 150°
Total Lead Angle (λ)(°)
35
30
25
20
15
10
5
0
-5
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-6


TARGET ASPECT ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Target Aspect Angle (T)(°)
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
T0 = 90°
T0 = 30°

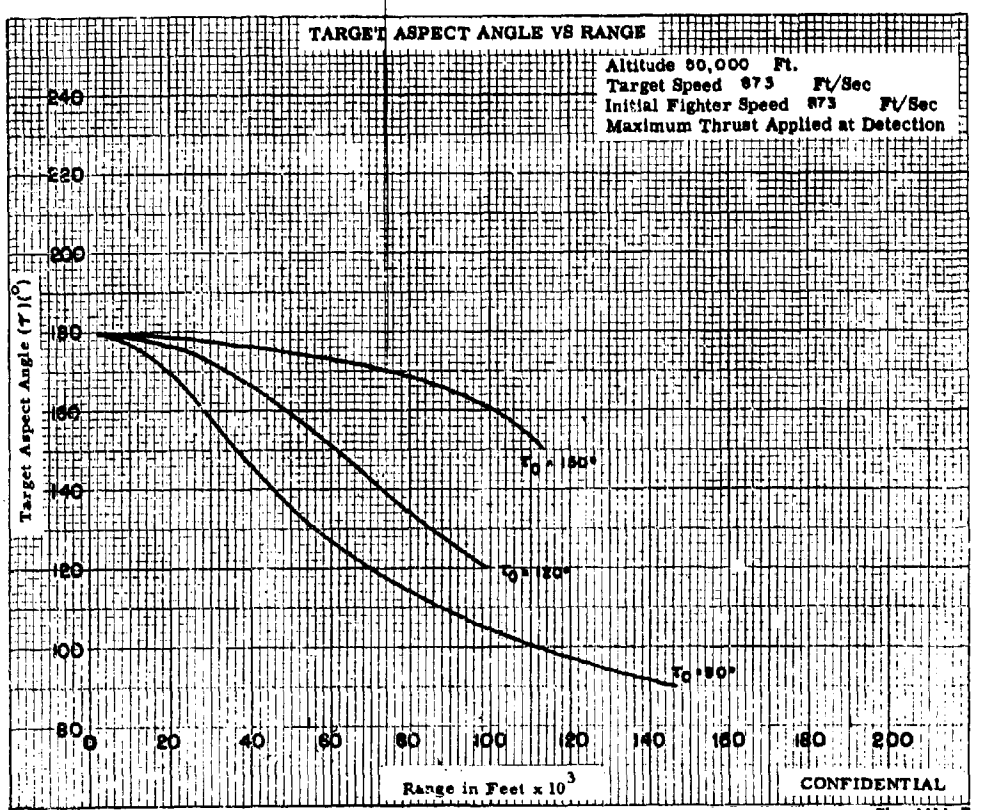
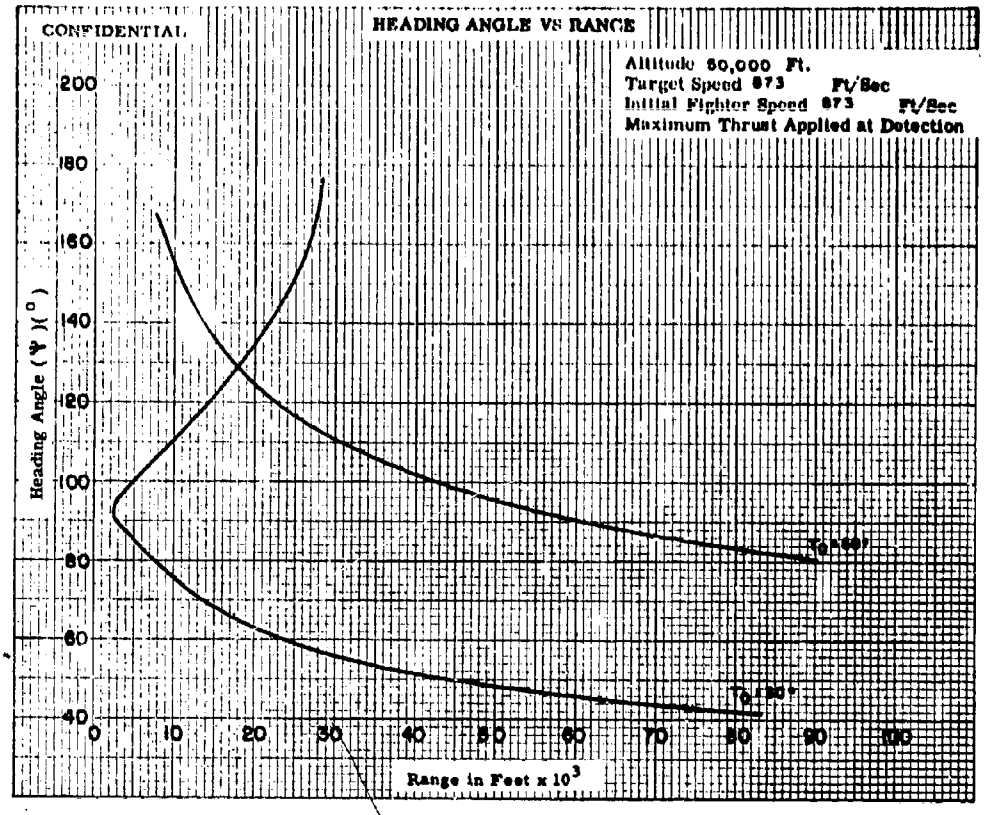

TARGET ASPECT ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Target Aspect Angle (T)(°)
240
220
200
180
160
140
120
100
80
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
T0 = 150°
T0 = 120°
T0 = 90°
CONFIDENTIAL

Fig. VII-7


HEADING ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Heading Angle (Ψ)(°)
200
180
160
140
120
100
80
60
40
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10³
T_0=60°
T_0=90°

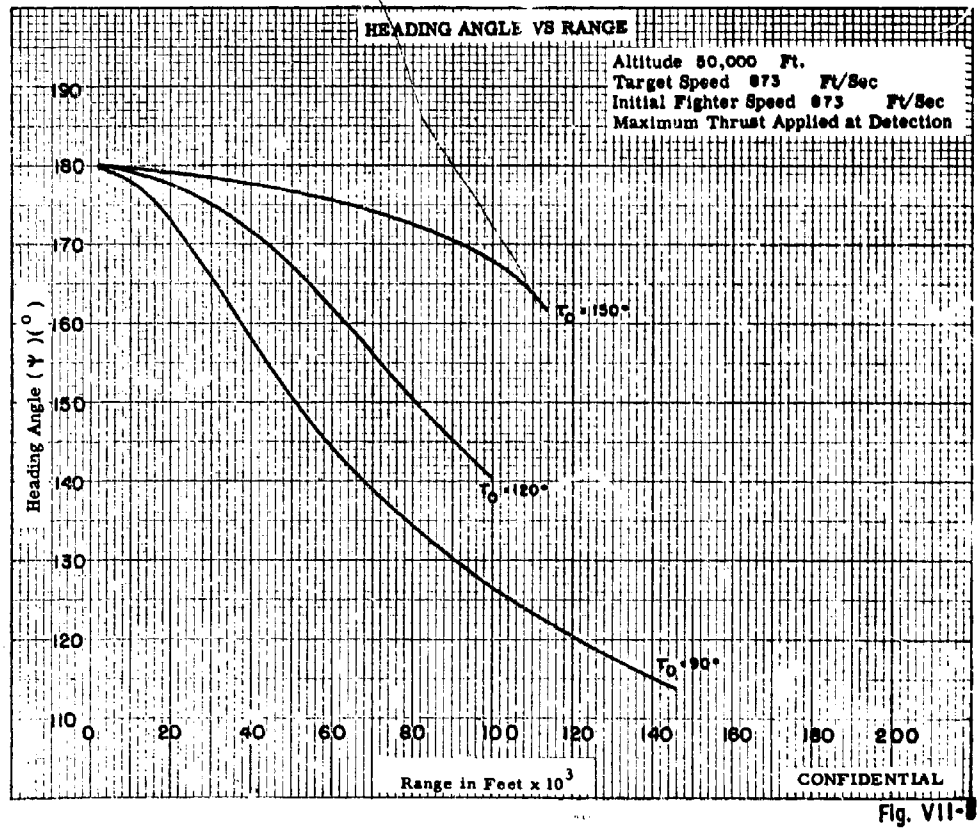
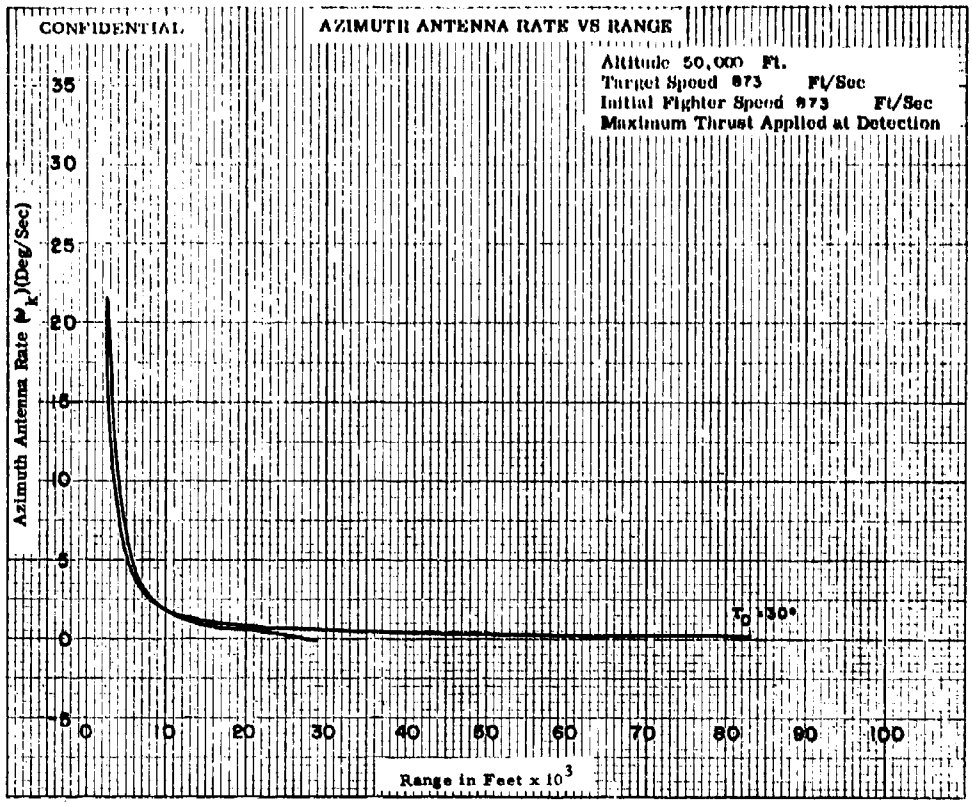

HEADING ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Heading Angle (Ψ)(°)
190
180
170
160
150
140
130
120
110
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10³
T_0=150°
T_0=120°
T_0=90°

Fig. VII-8


CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Antenna Rate ($\dot{\psi}_k$)(Deg/Sec)
35
30
25
20
15
10
5
0
-5
T_0 =30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

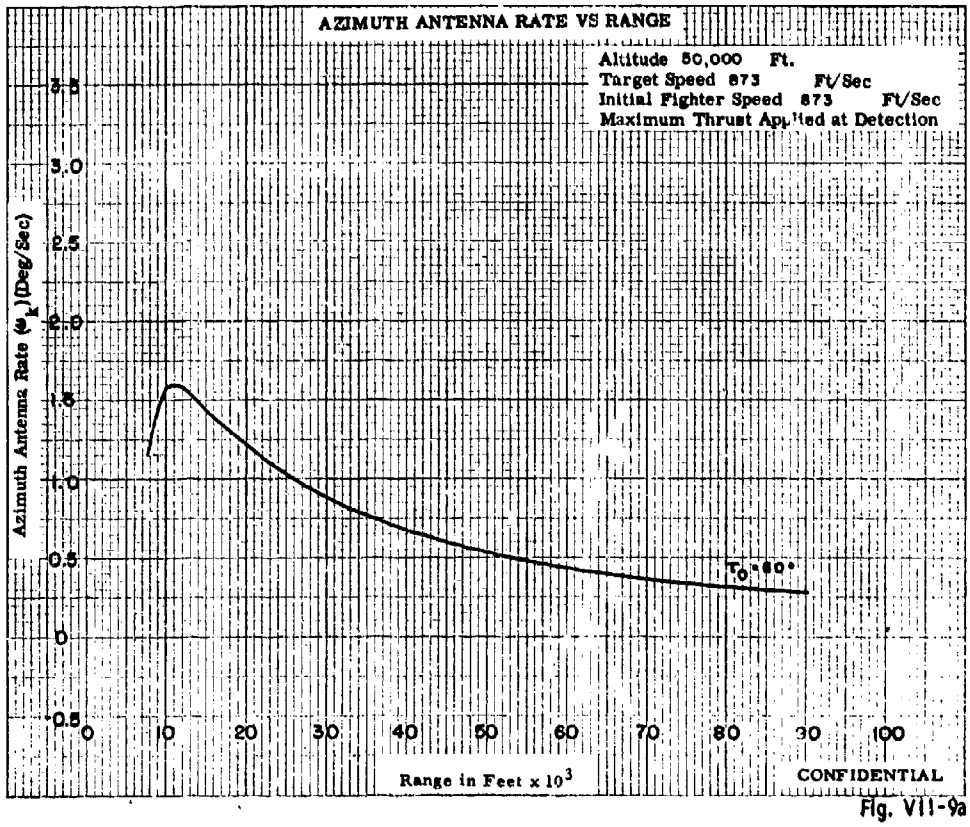

AZIMUTH ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Antenna Rate ($\dot{\psi}_k$)(Deg/Sec)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
T_0 =60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-9a

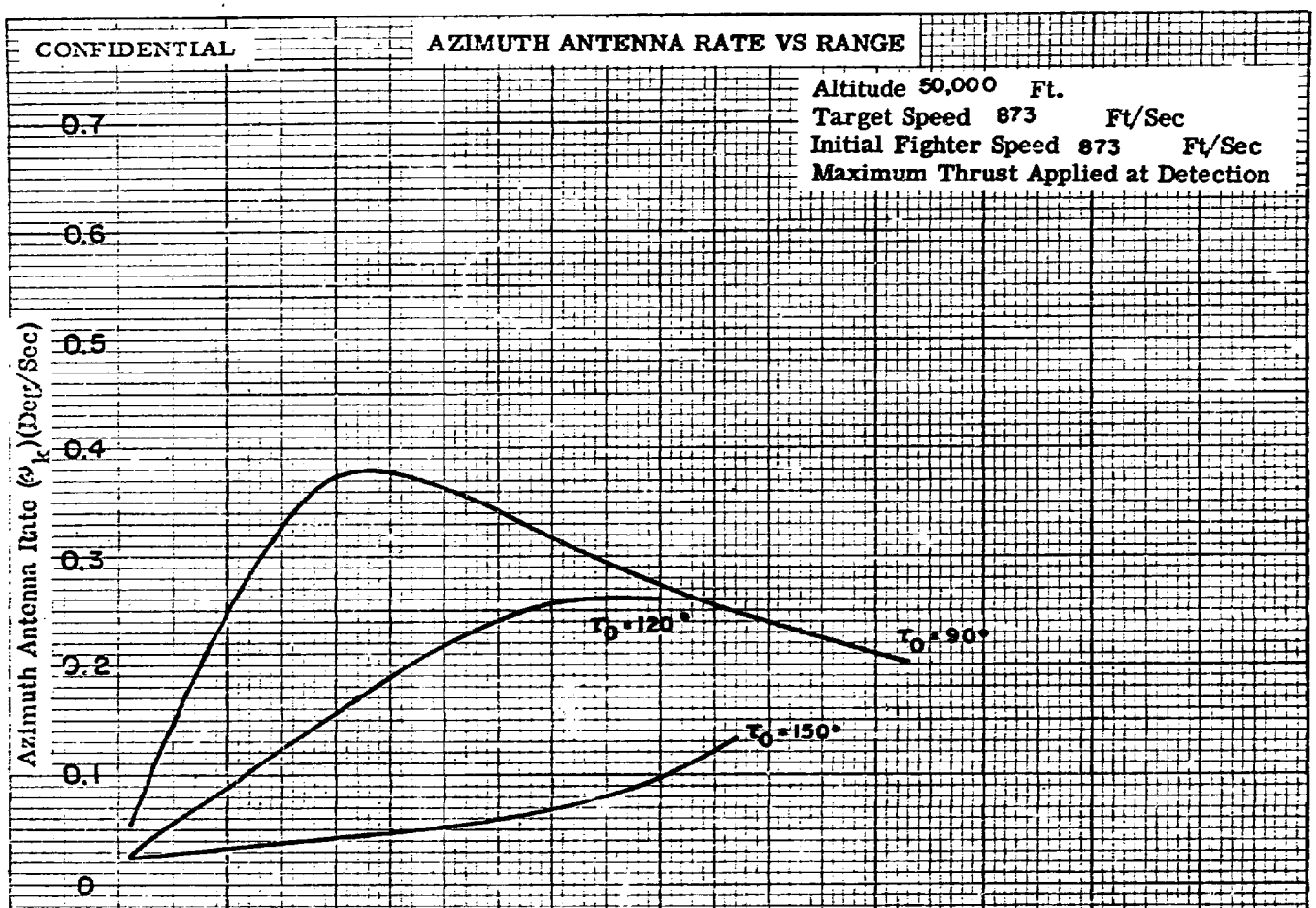
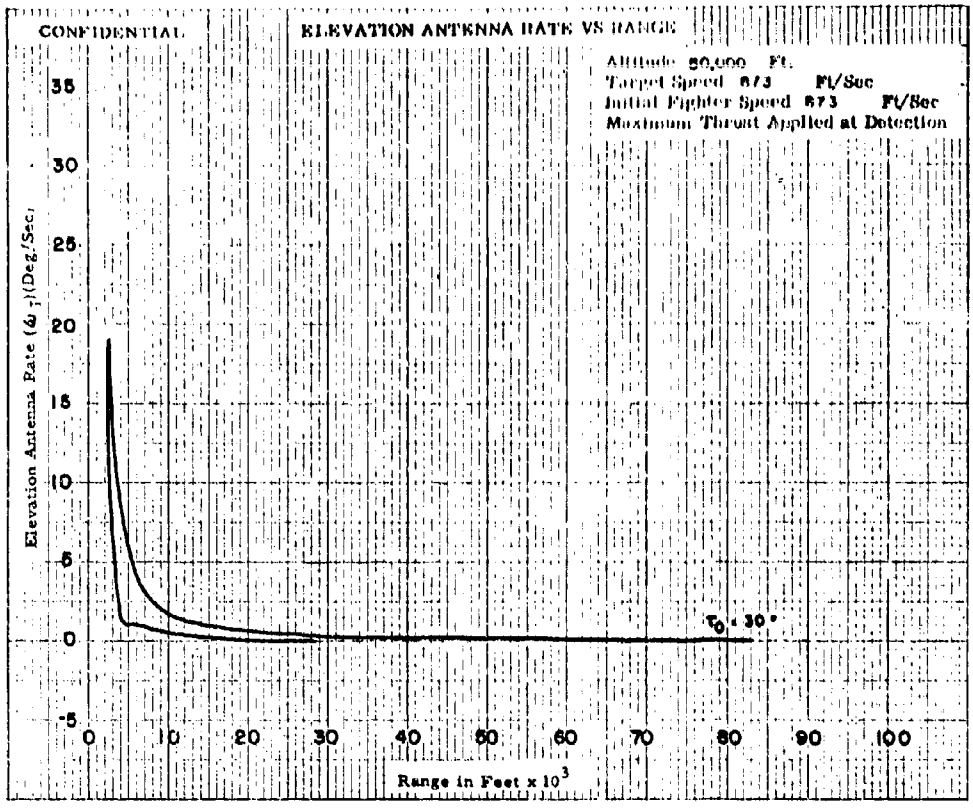

CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Antenna Rate (ω_k)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
τ_0=120°
τ_0=90°
τ_0=150°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-9b


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate ($\dot{\epsilon}_T$)(Deg./Sec)
35
30
25
20
15
10
5
0
-5
τ_0 = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

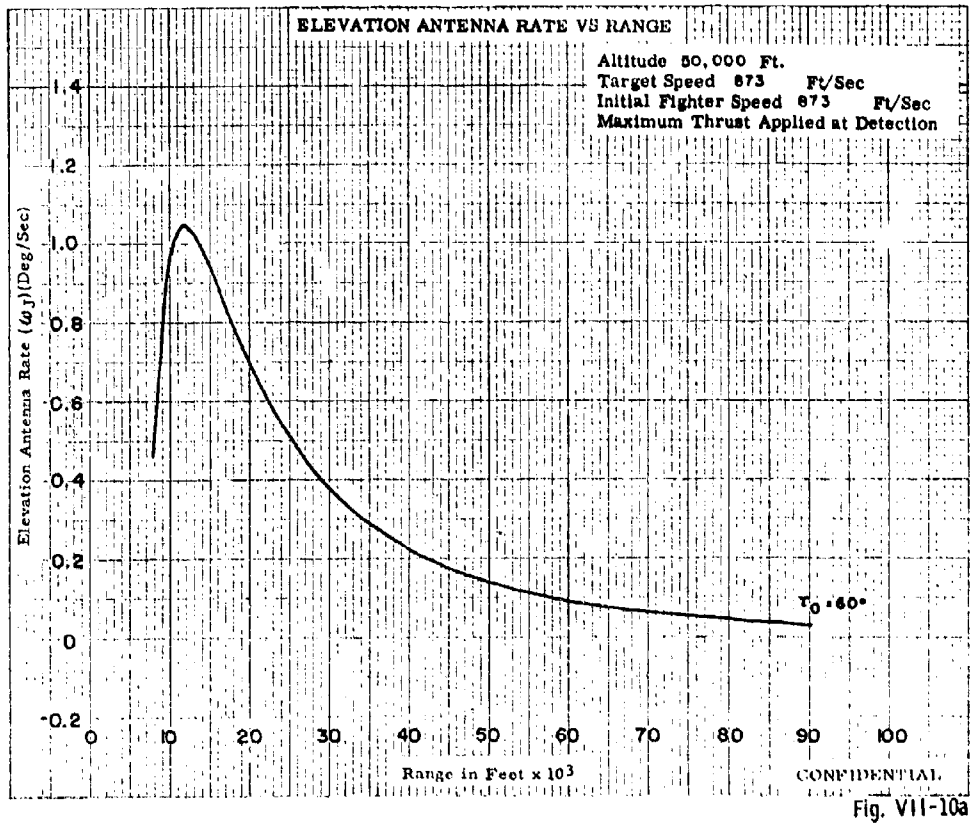
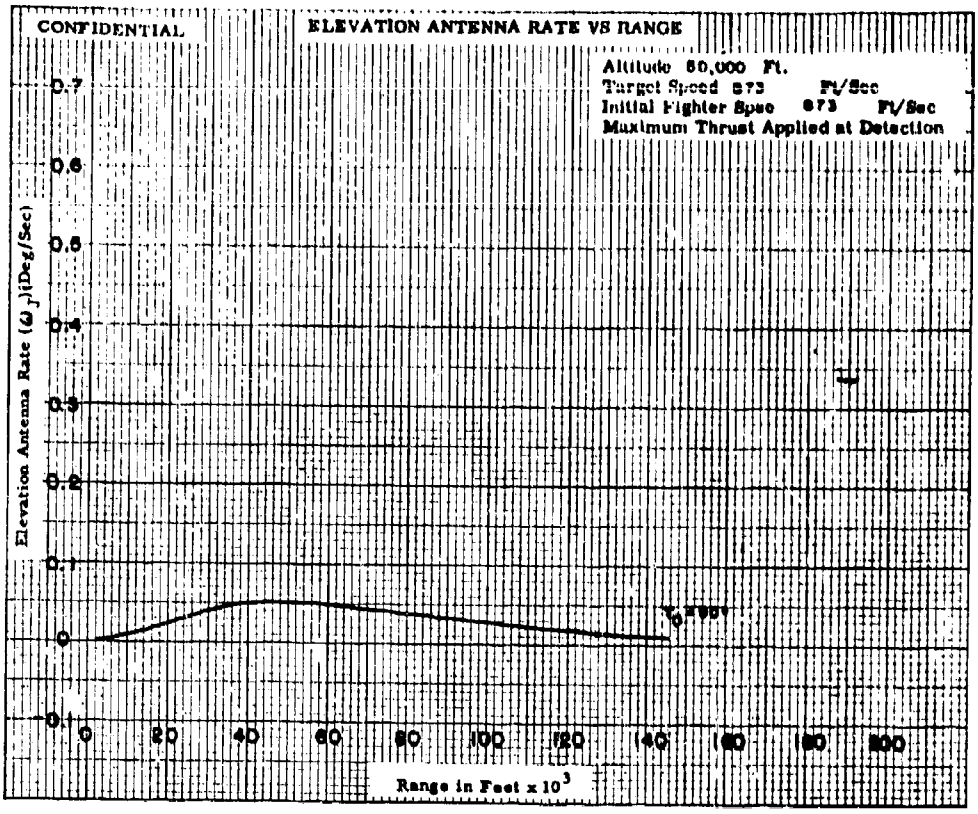

ELEVATION ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate (ω_T)(Deg/Sec)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
τ_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-10a


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 60,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Spee 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate (ω_E)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

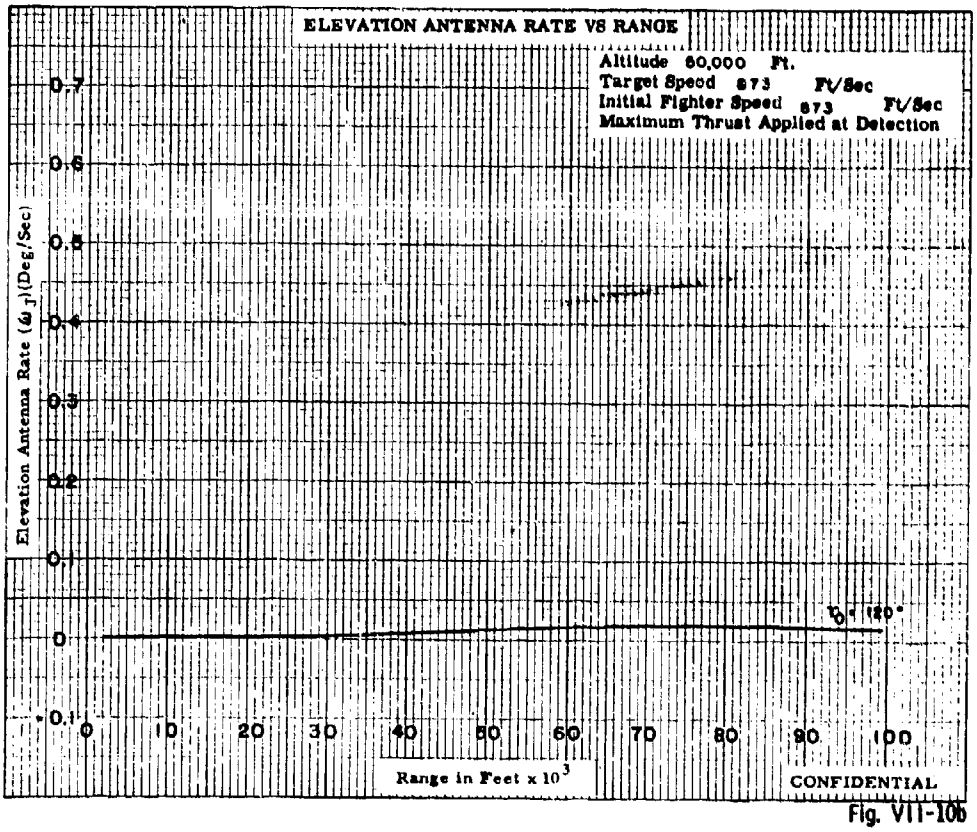

ELEVATION ANTENNA RATE VS RANGE
Altitude 60,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate (ω_E)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-10b

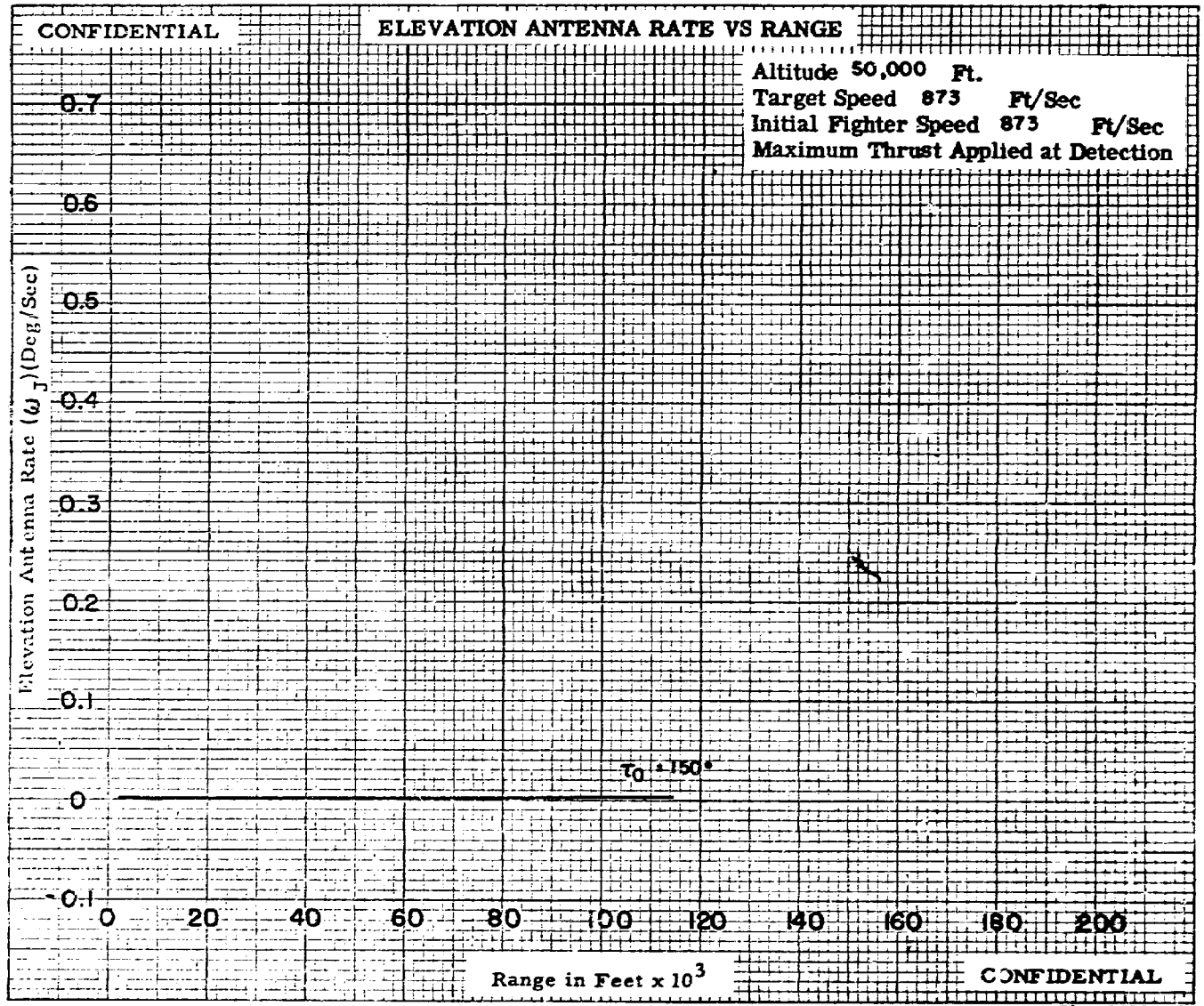
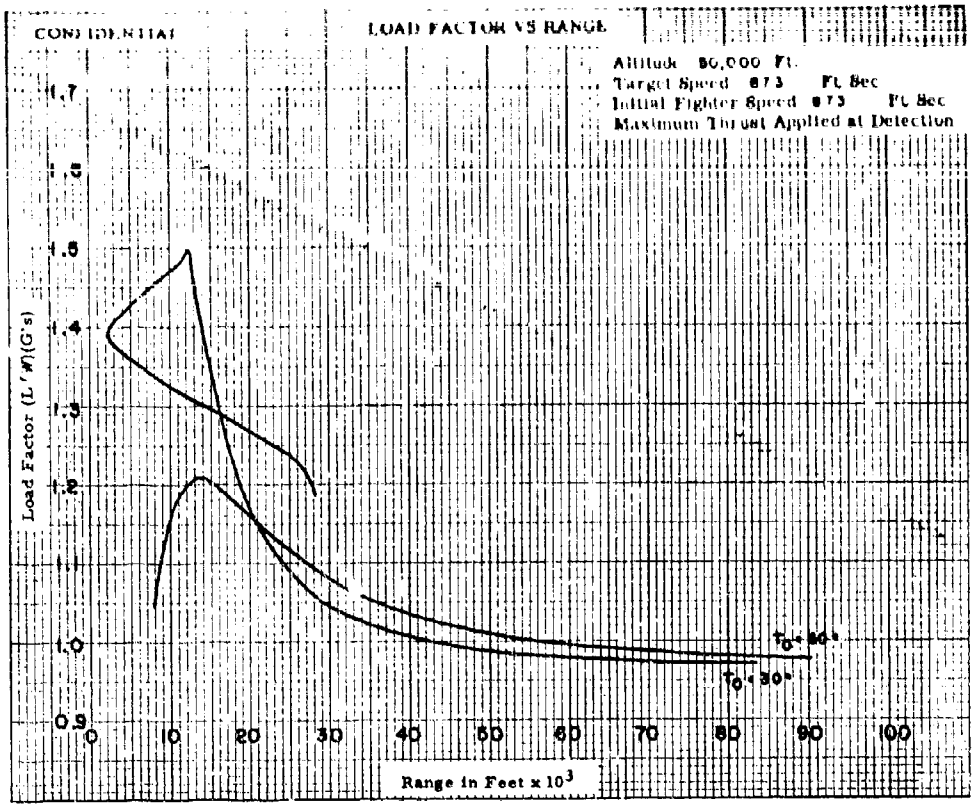

CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate (ω_J)(Deg/Sec)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
τ_0 = 150°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-10c


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft Sec
Initial Fighter Speed 873 Ft Sec
Maximum Thrust Applied at Detection
Load Factor (L/W)(G's)
1.7
1.6
1.4
1.3
1.2
1.1
1.0
0.9
T_D = 60°
T_D = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

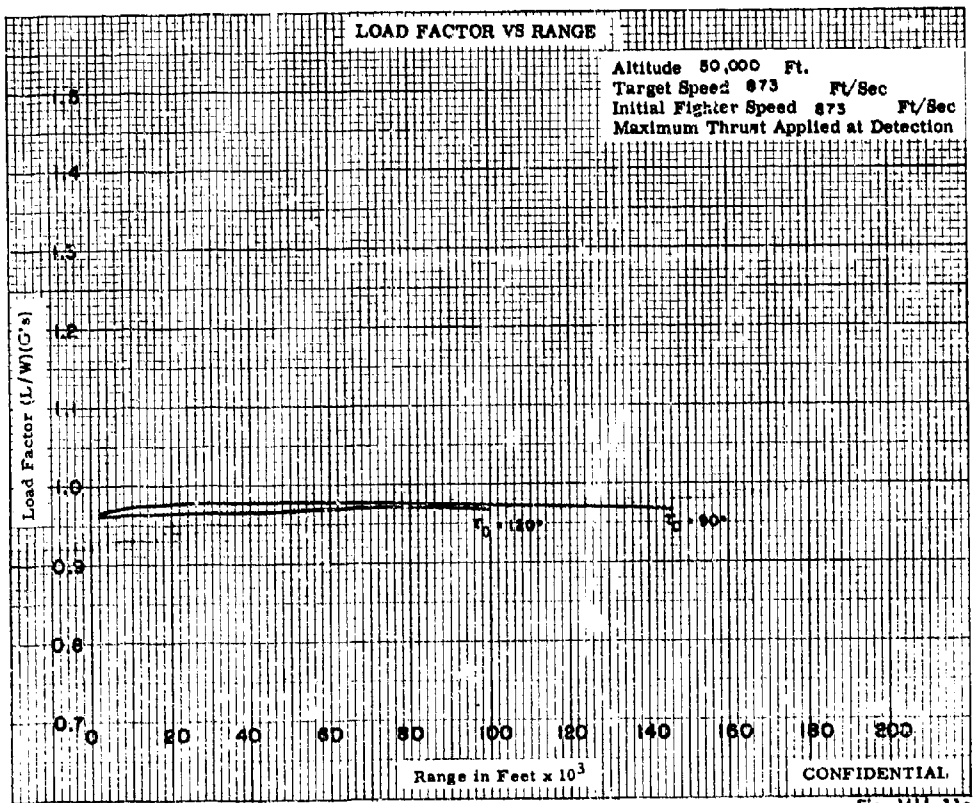

LOAD FACTOR VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Load Factor (L/W)(G's)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
T_D = 120°
T_D = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-11a

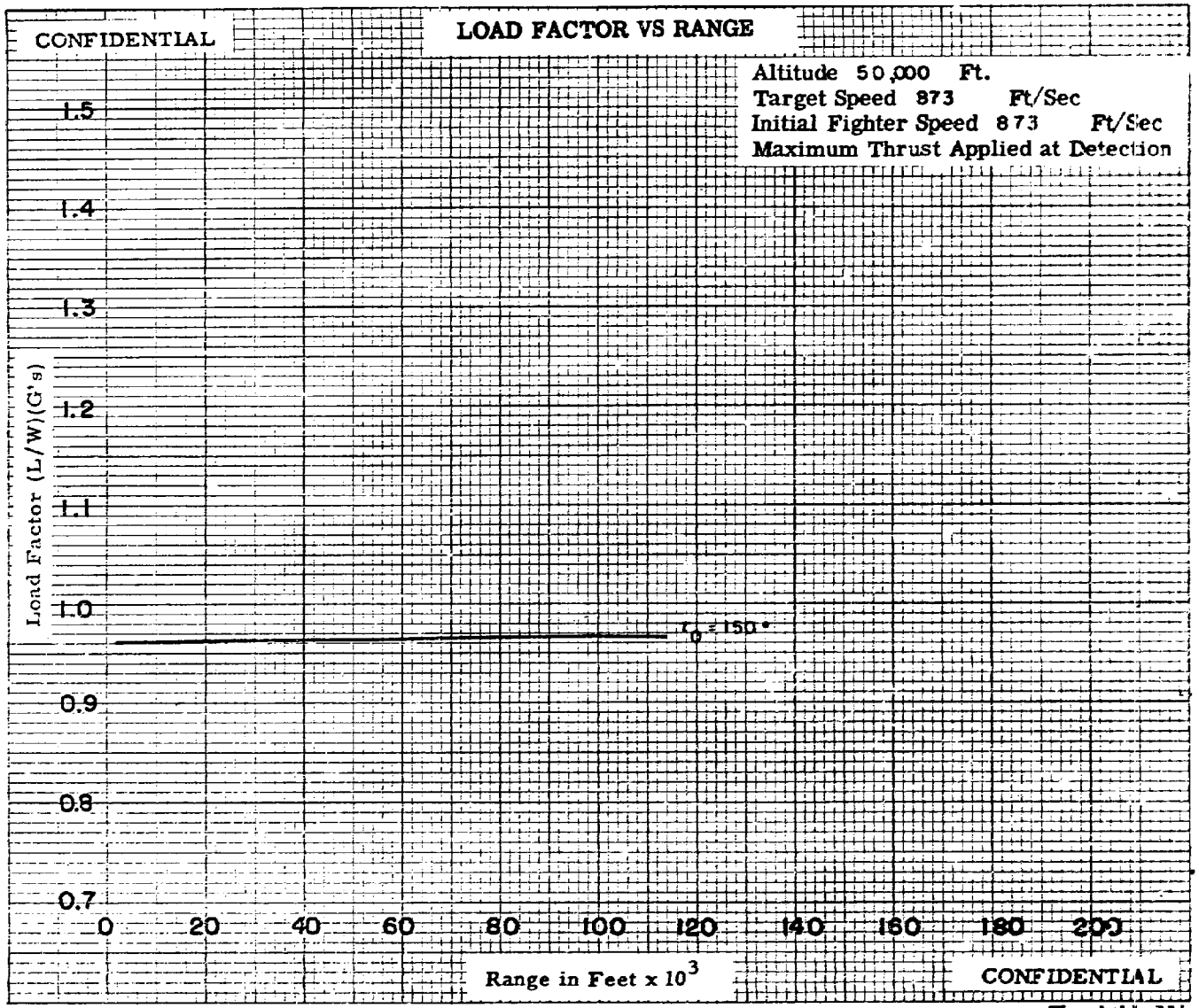
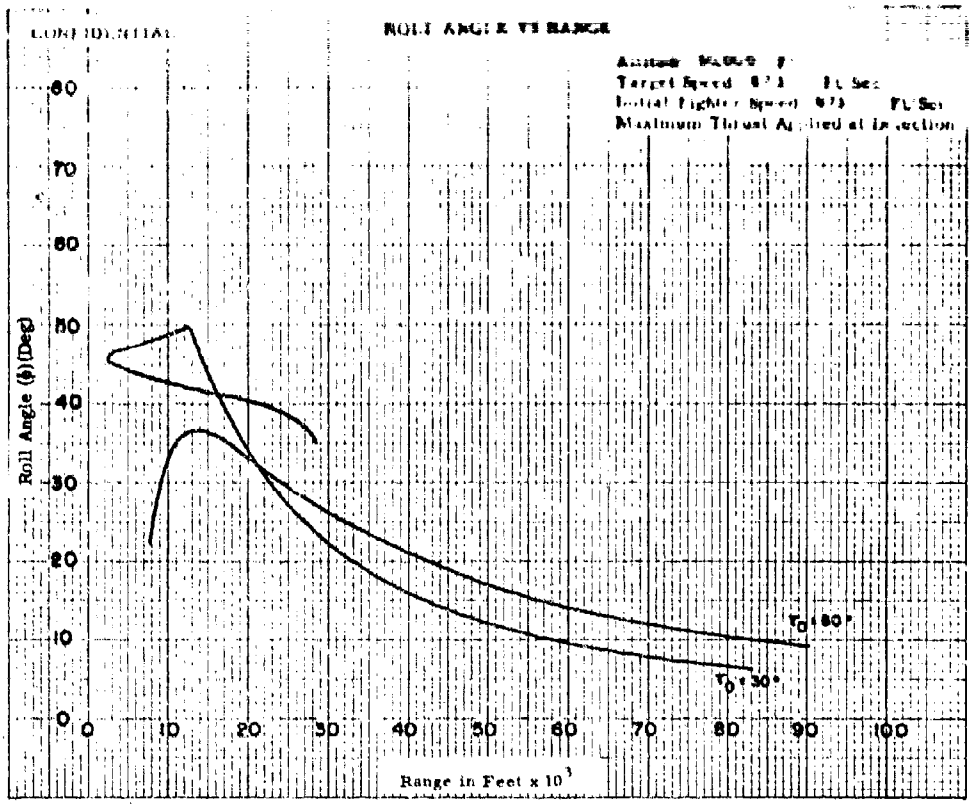

CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Load Factor (L/W)(G's)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
$\tau_0 = 150°$
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. VII-11b


CONFIDENTIAL
ROLL ANGLE VS RANGE
Roll Angle (ϕ)(Deg)
Range in Feet x 10³
T_0 = 60°
T_0 = 30°

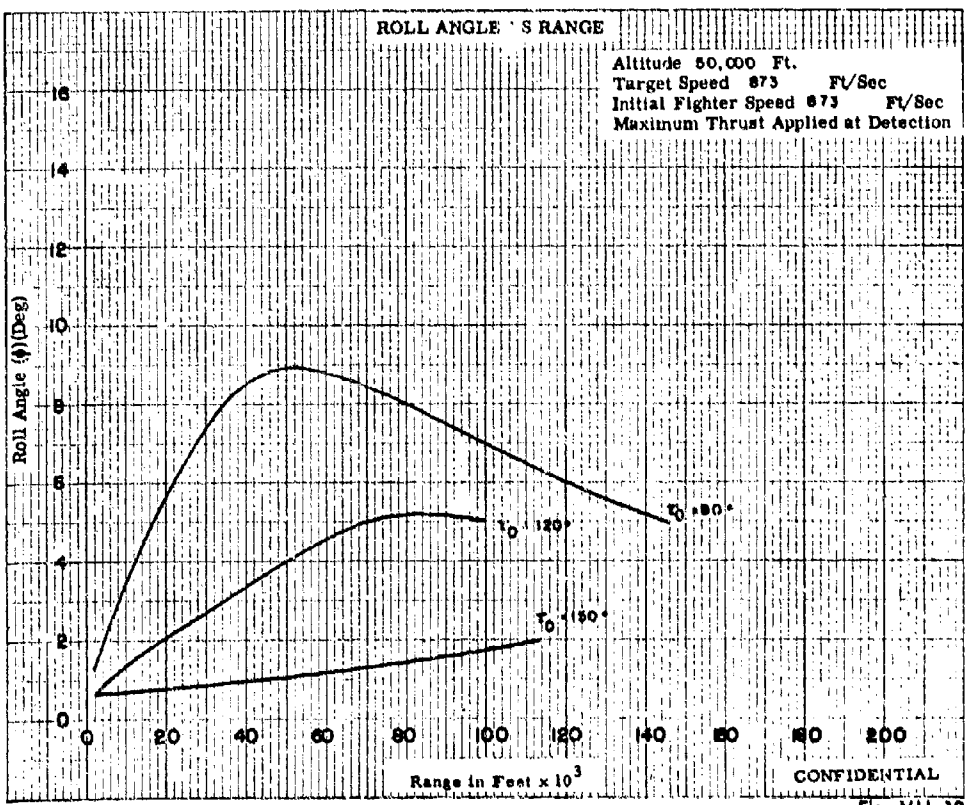
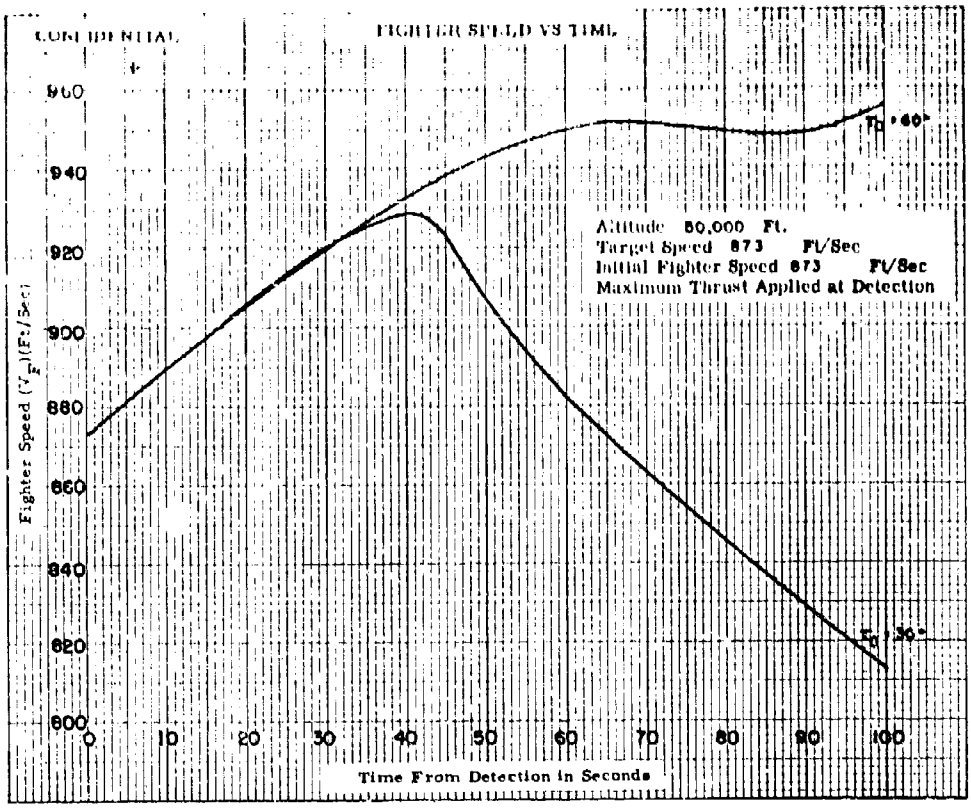

ROLL ANGLE VS RANGE
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Roll Angle (ϕ)(Deg)
Range in Feet x 10³
T_0 = 120°
T_0 = 90°
T_0 = 150°
CONFIDENTIAL

Fig. VII-12


CONFIDENTIAL
FIGHTER SPEED VS TIME
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Γ_D = 60°
Γ_D = 30°
Fighter Speed (V_F)(Ft/Sec)
960
940
920
900
880
860
840
820
600
0
10
20
30
40
50
60
70
80
90
100
Time From Detection in Seconds

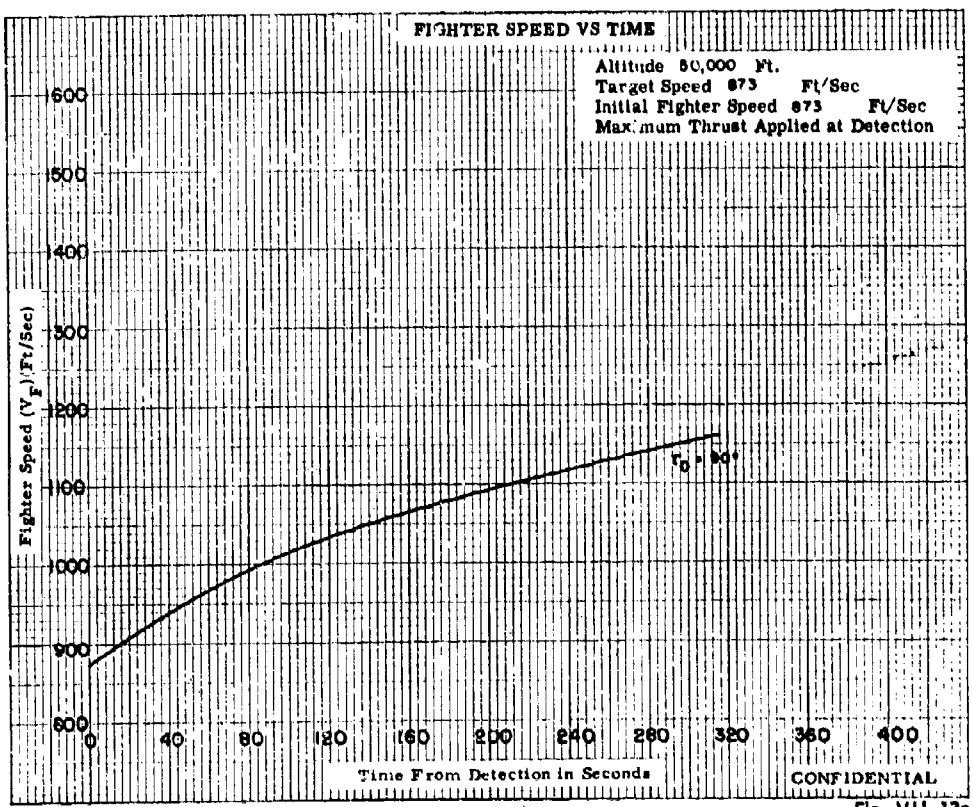
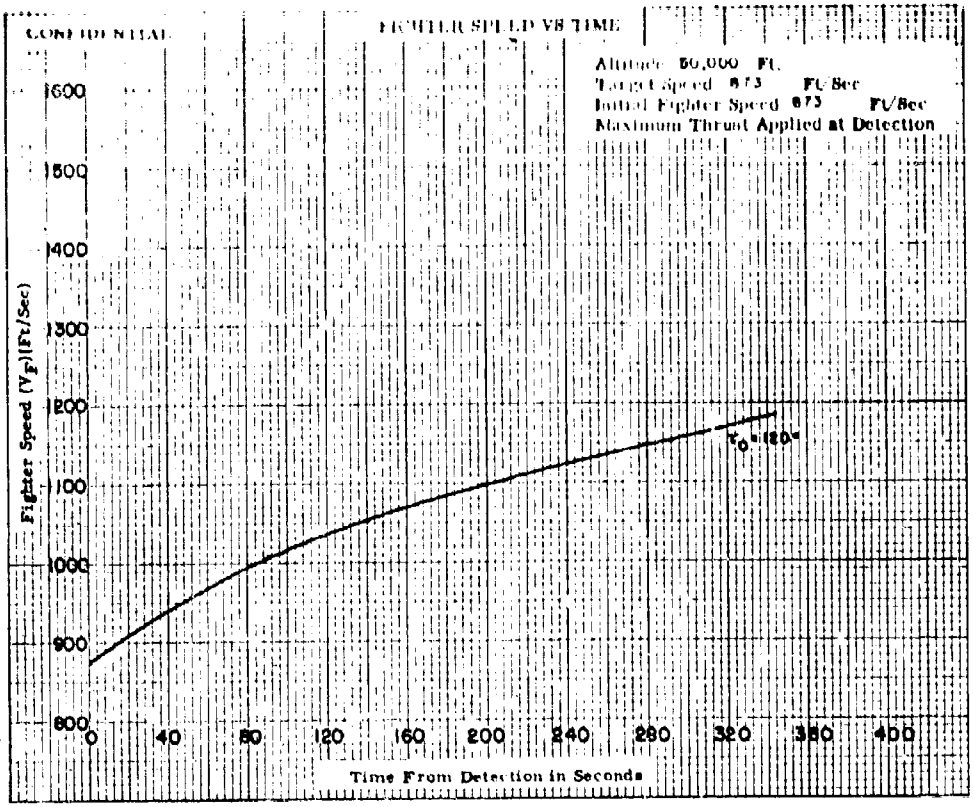

FIGHTER SPEED VS TIME
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Γ_D = 90°
Fighter Speed (V_F)(Ft/Sec)
600
500
400
300
1200
1100
1000
900
800
0
40
80
120
160
200
240
280
320
360
400
Time From Detection in Seconds
CONFIDENTIAL

Fig. VII-13


CONFIDENTIAL
FIGHTER SPEED VS TIME
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Fighter Speed (V_F) (Ft/Sec)
1600
1500
1400
1300
1200
1100
1000
900
800
T_D = 180°
0
40
80
120
160
200
240
280
320
360
400
Time From Detection in Seconds

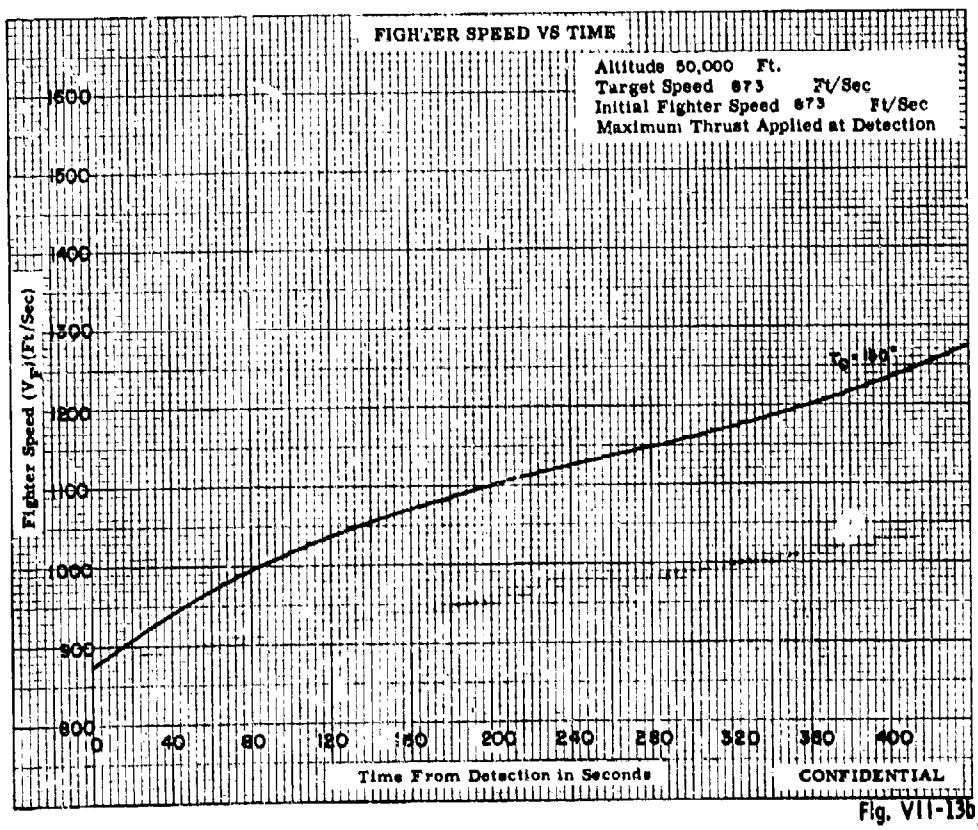
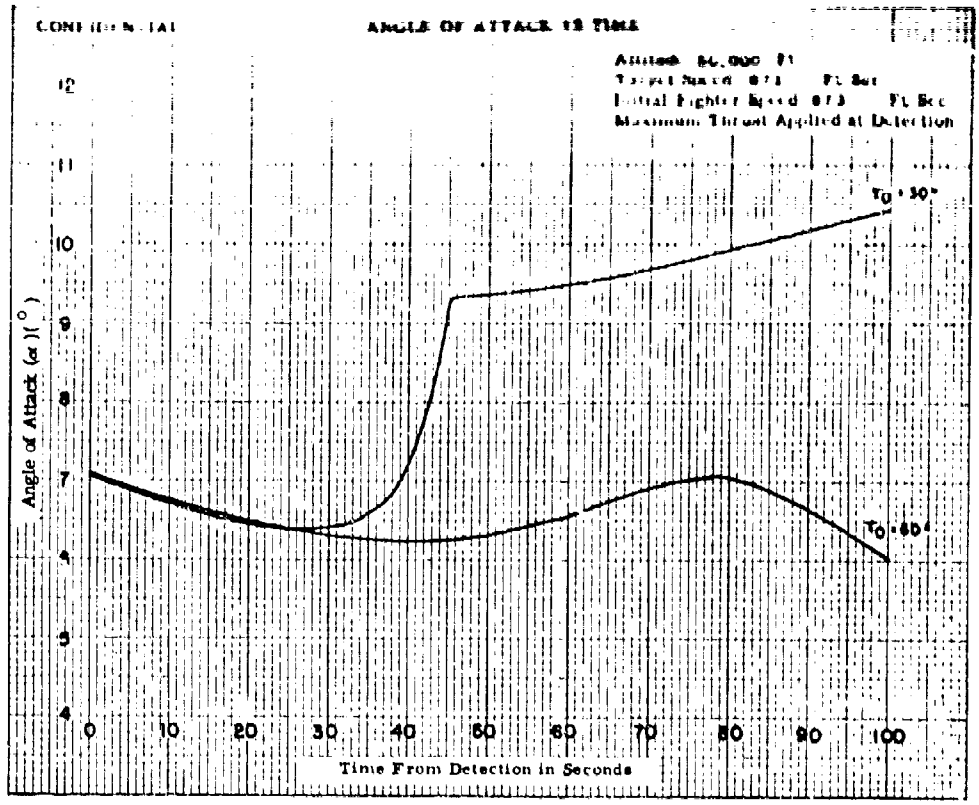

FIGHTER SPEED VS TIME
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Fighter Speed (V_F) (Ft/Sec)
1600
1500
1400
1300
1200
1100
1000
900
800
T_D = 180°
0
40
80
120
160
200
240
280
320
360
400
Time From Detection in Seconds
CONFIDENTIAL

Fig. VII-13b


CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 50,000 Ft
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
T_D = 30°
T_D = 60°
Angle of Attack (α) (°)
12
11
10
9
8
7
6
5
4
0
10
20
30
40
50
60
70
80
90
100
Time From Detection in Seconds

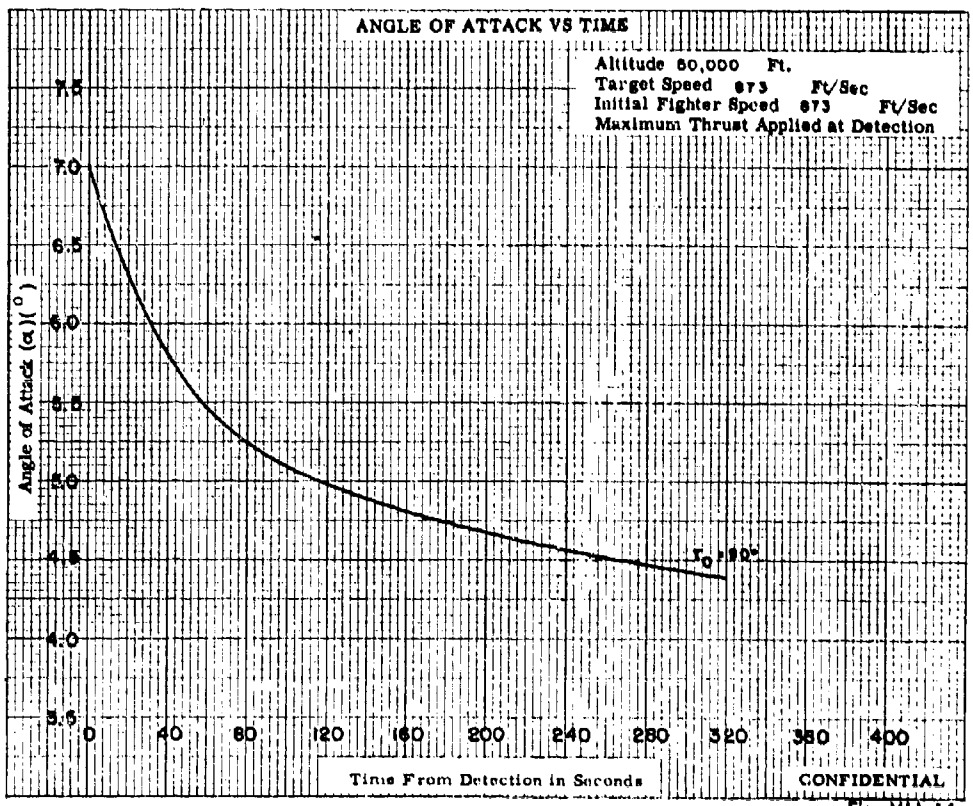
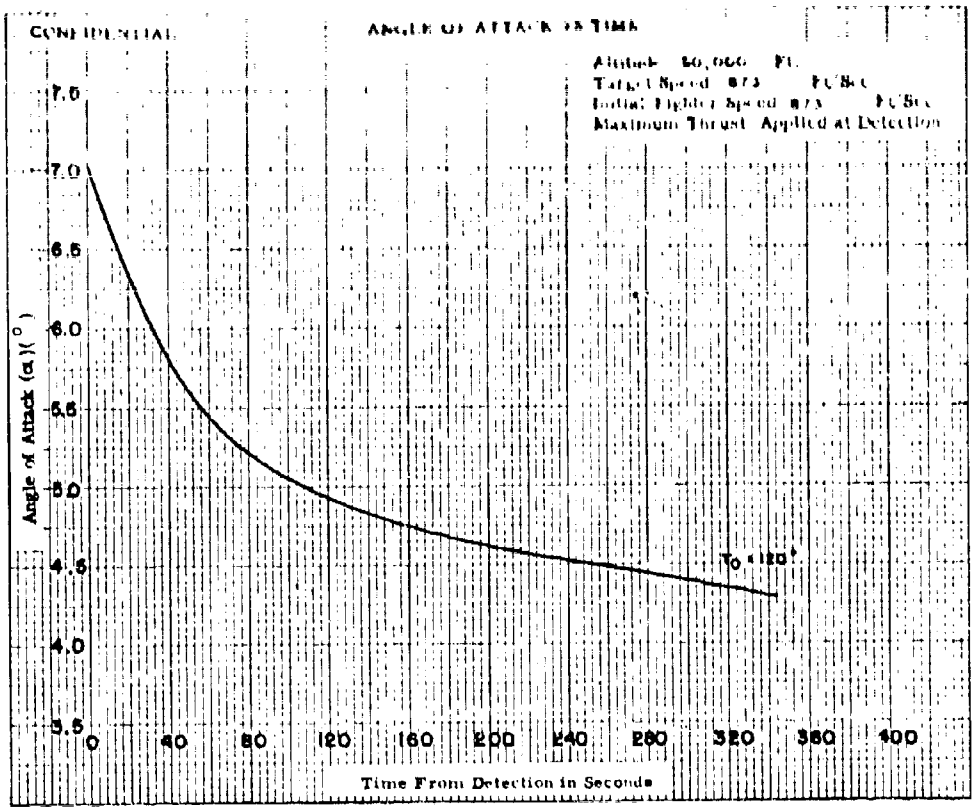

ANGLE OF ATTACK VS TIME
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
T_D = 30°
Angle of Attack (α) (°)
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
0
40
80
120
160
200
240
280
320
360
400
Time From Detection in Seconds
CONFIDENTIAL

Fig. VII-14a


CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Angle of Attack (α)(°)
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
0
40
80
120
160
200
240
280
320
360
400
T_0 = 120°
Time From Detection in Seconds

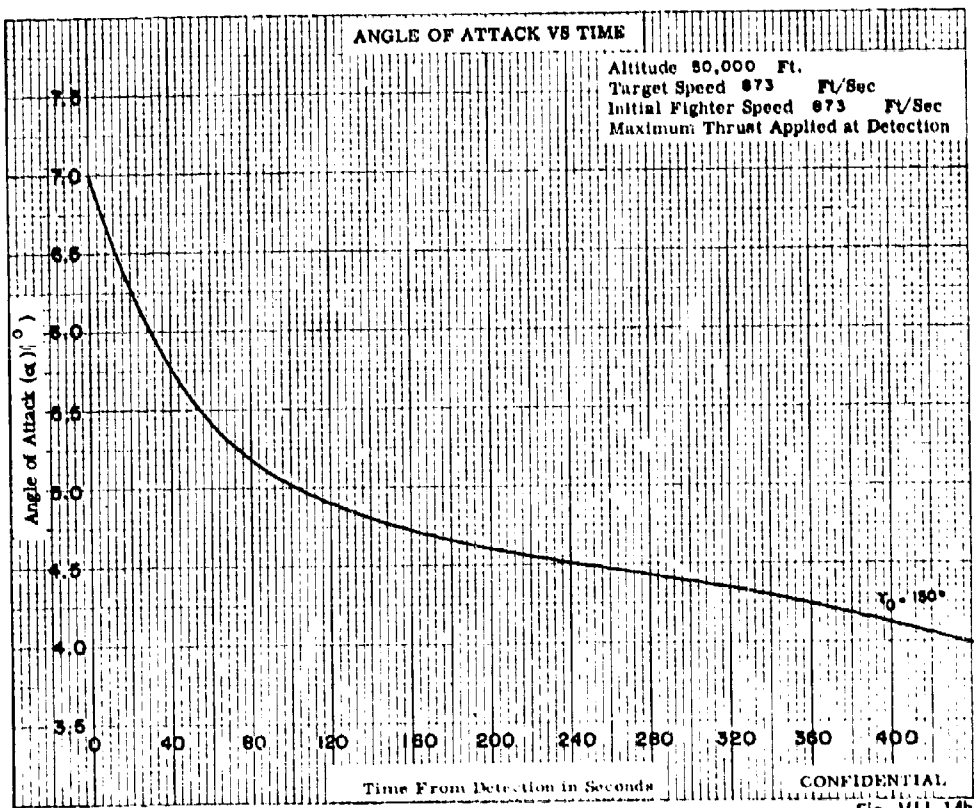
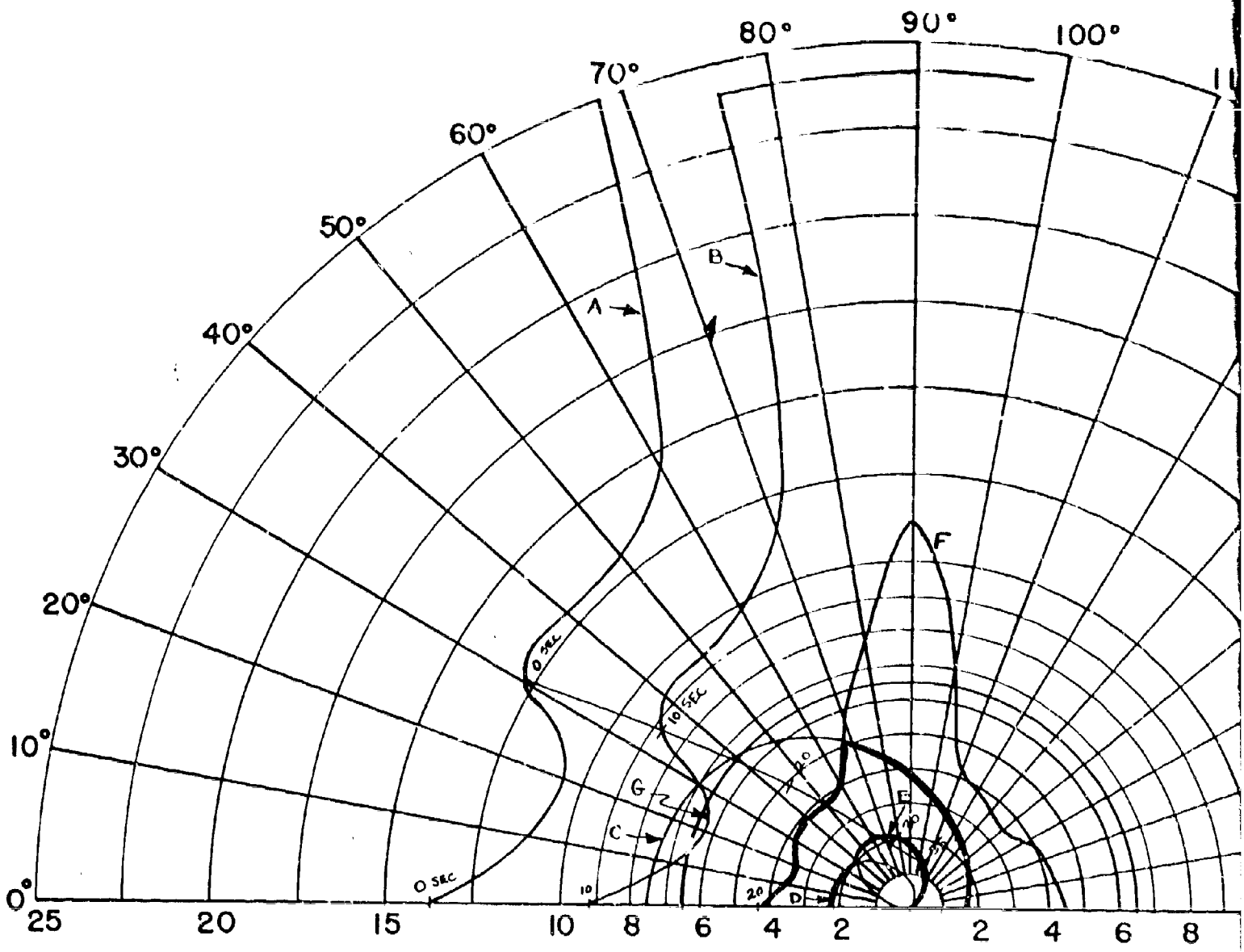

ANGLE OF ATTACK VS TIME
Altitude 50,000 Ft.
Target Speed 873 Ft/Sec
Initial Fighter Speed 873 Ft/Sec
Maximum Thrust Applied at Detection
Angle of Attack (α)(°)
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
0
40
80
120
160
200
240
280
320
360
400
T_0 = 150°
Time From Detection in Seconds
CONFIDENTIAL

Fig. VII-14b



V_F = 894 FT/SEC (F4H-1)(F8U-3)

V_T = 1897 FT/SEC

ALTITUDE = 30,000 FT.

INCREASED THRUST AT DETECTION

← TARGET HEADING

A - 85% DETECTION RANGE

B - LOCK-ON RANGE (10 SEC. LOCK-ON TIME

C - SPARROW III MAX. AERODYNAMIC RANG

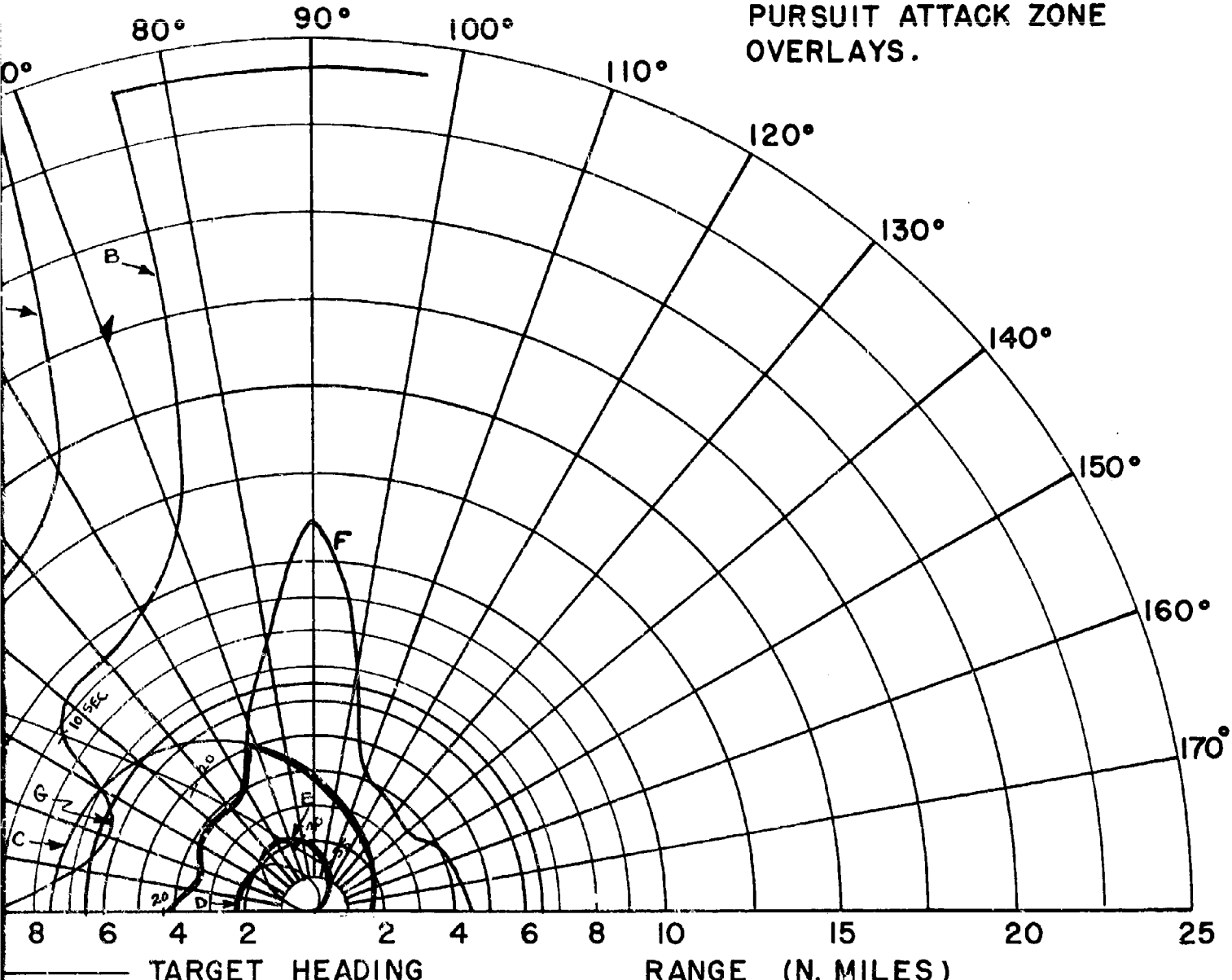
D - SPARROW III MIN. AERODYNAMIC RANG

E - CONSTANT LOAD FACTOR LOCUS (N_Z =

F - 90% SPARROW III SEEKER LOCK-ON R

G - 6.5 N.M. INTERLOCK

FIG. VIII - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS.



85% DETECTION RANGE
LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
SPARROW III MAX. AERODYNAMIC RANGE
SPARROW III MIN. AERODYNAMIC RANGE
CONSTANT LOAD FACTOR LOCUS ($N_Z = 3$)
90% SPARROW III SEEKER LOCK-ON RANGE
6.5 N.M. INTERLOCK

CONFIDENTIAL

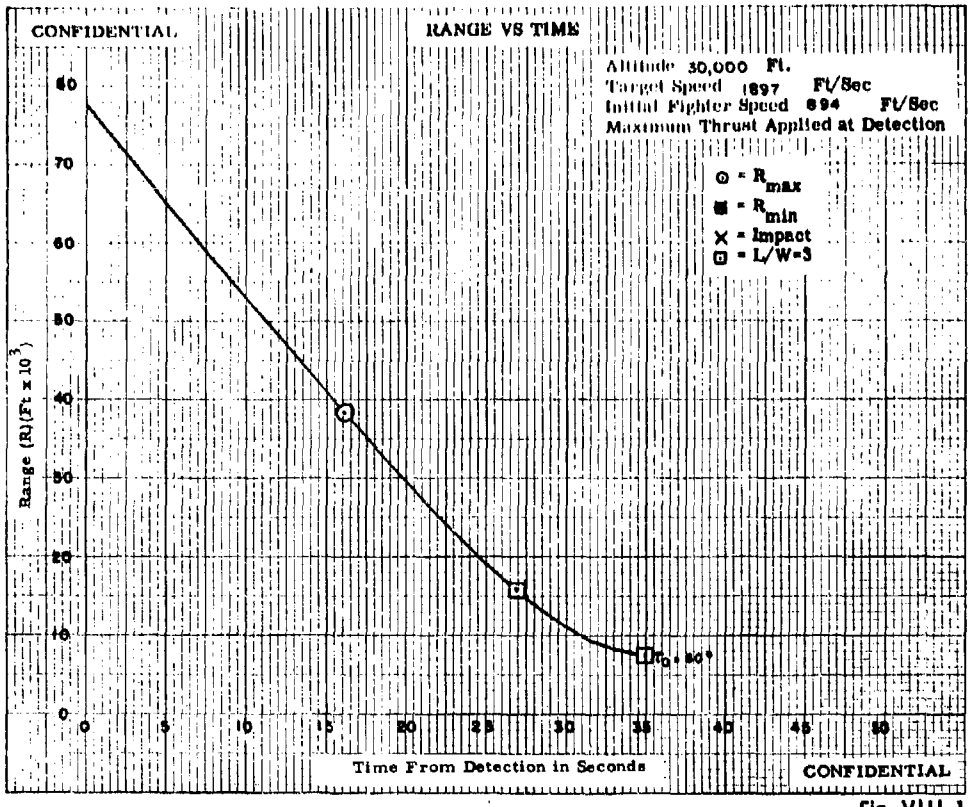


Fig. VIII-1

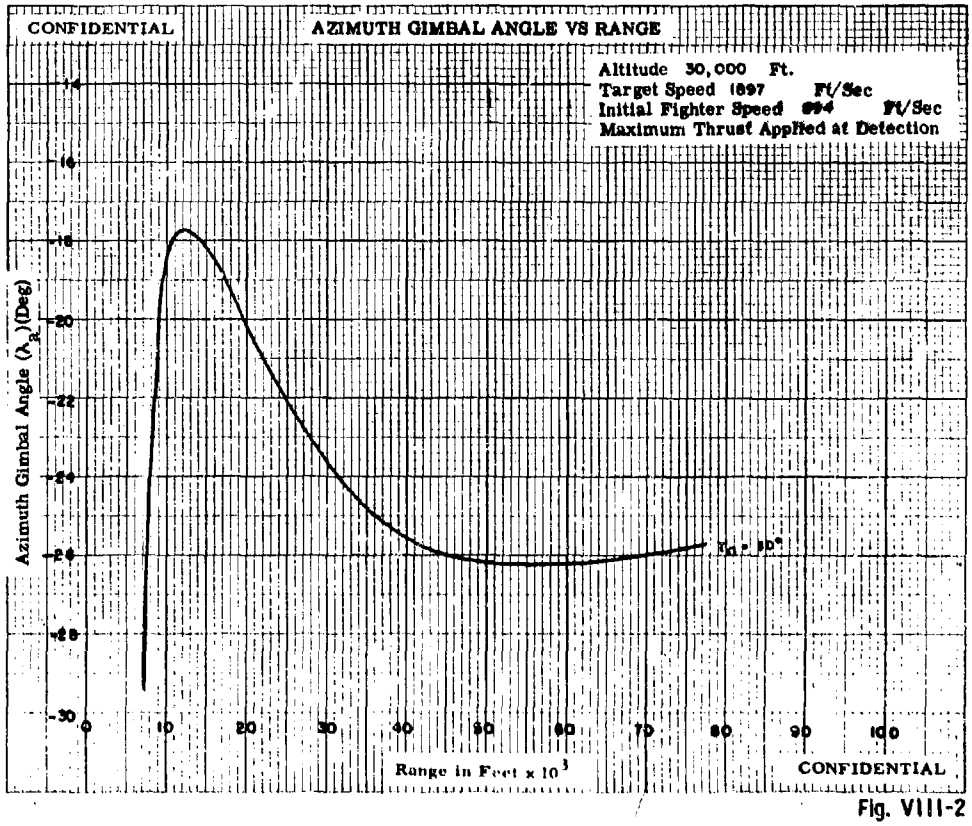


Fig. VIII-2

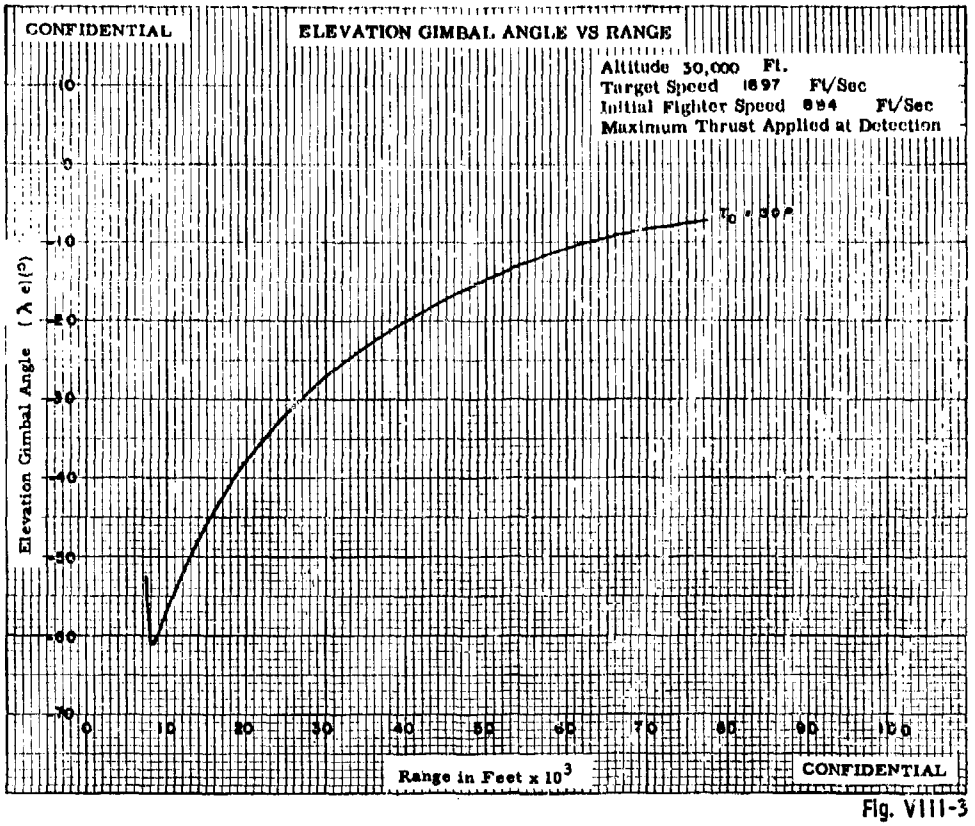


Fig. VIII-3

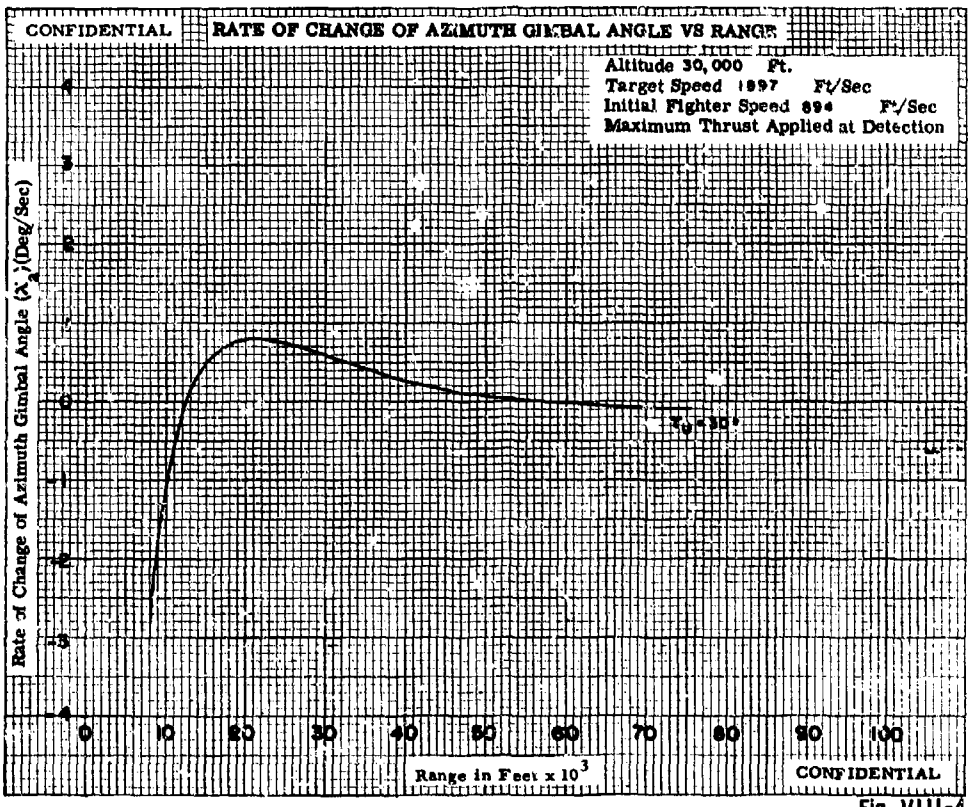


Fig. VIII-4

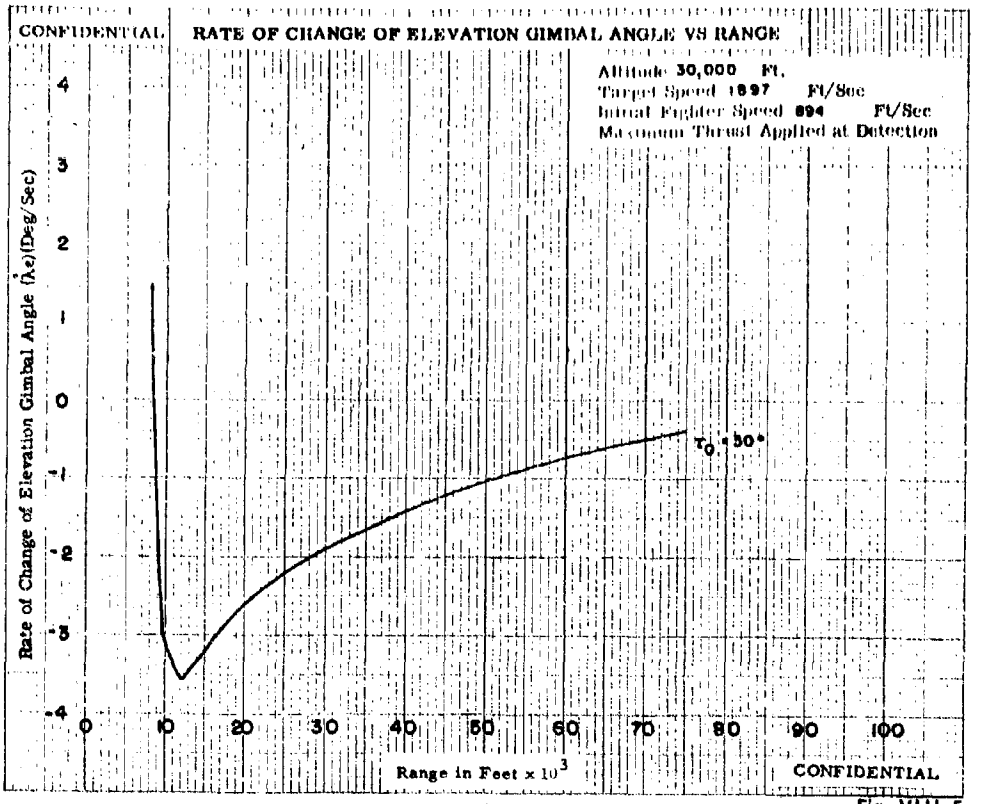


Fig. VIII-5

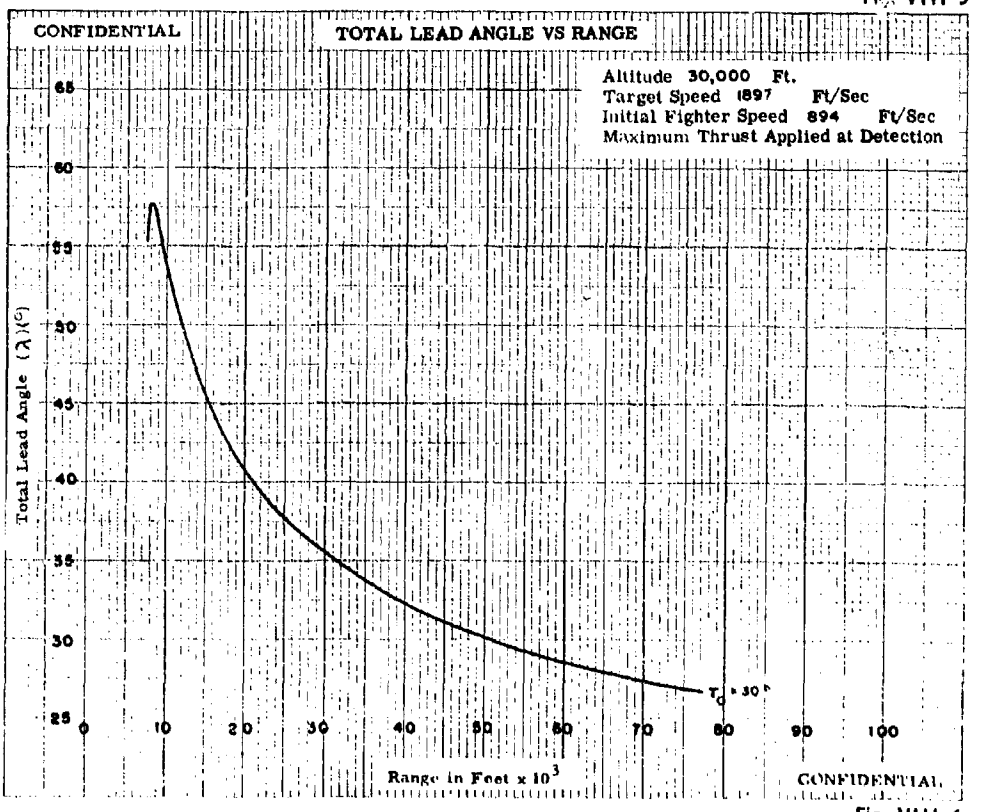


Fig. VIII-6

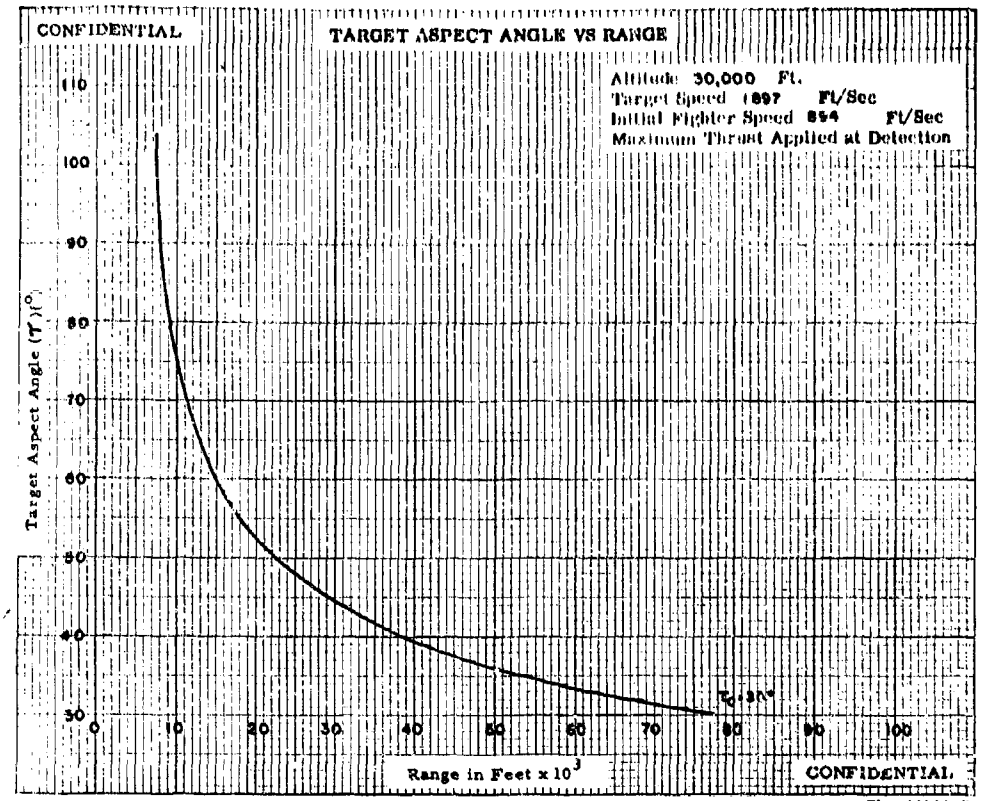


Fig. VIII-7

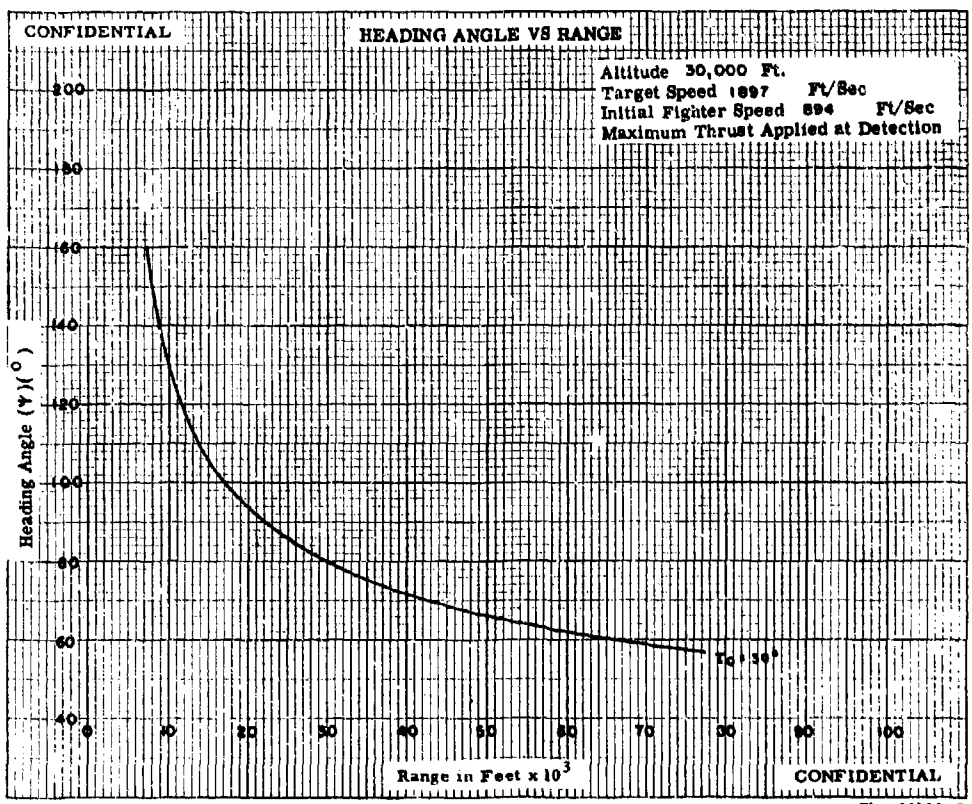


Fig. VIII-8

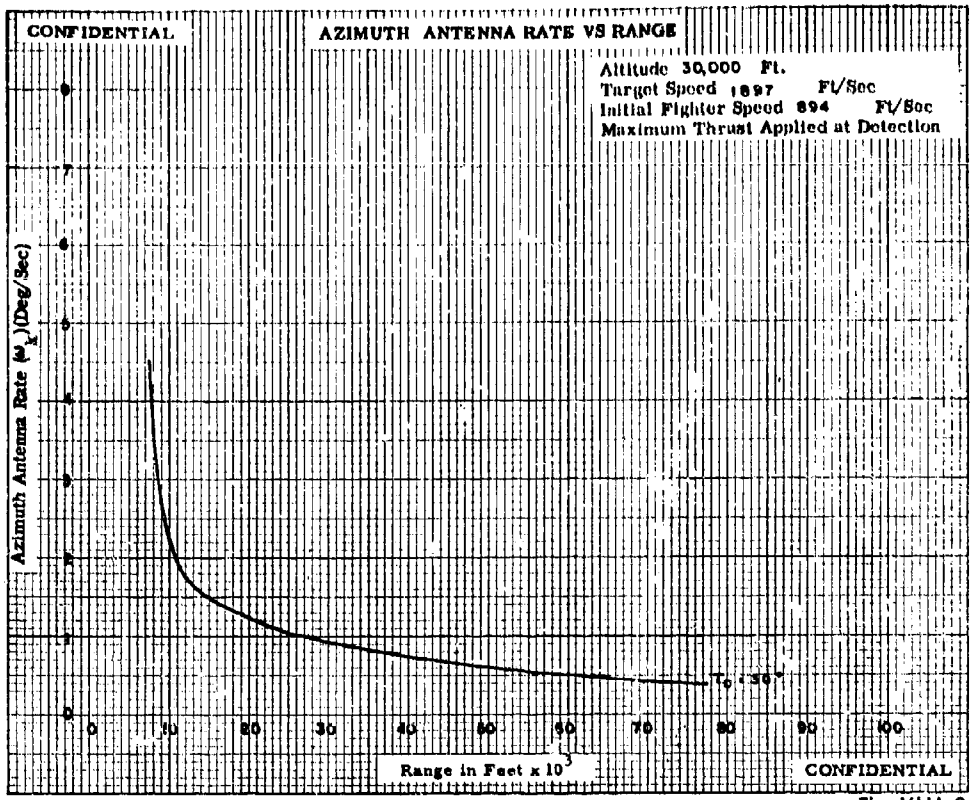


Fig. VIII-9

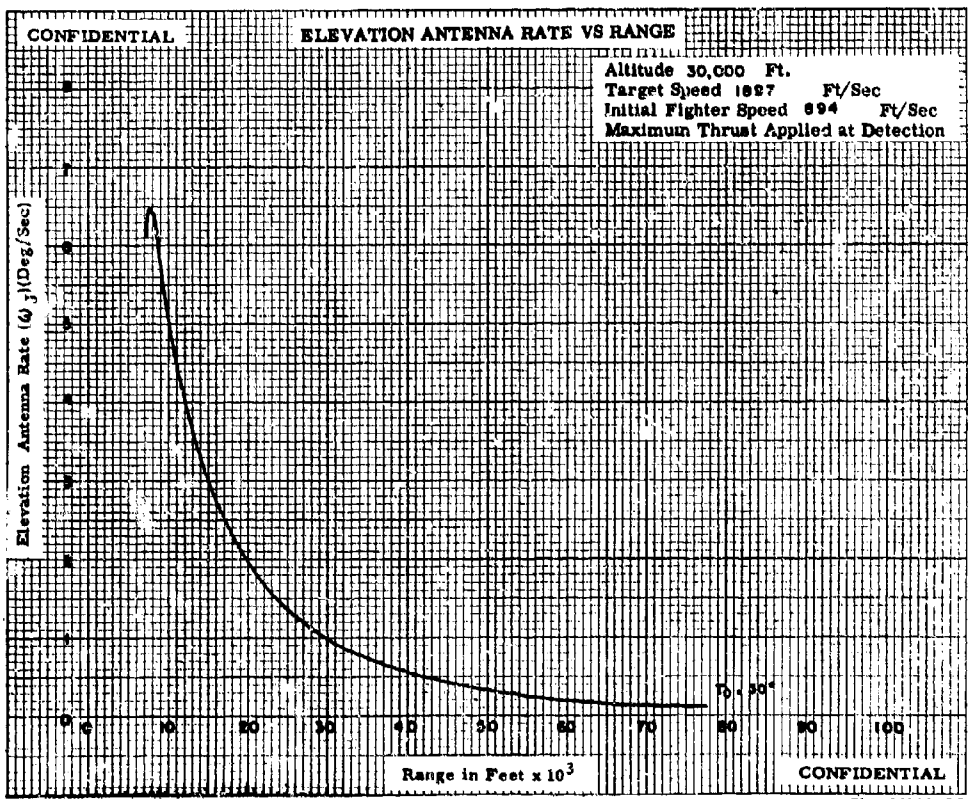


Fig. VIII-10

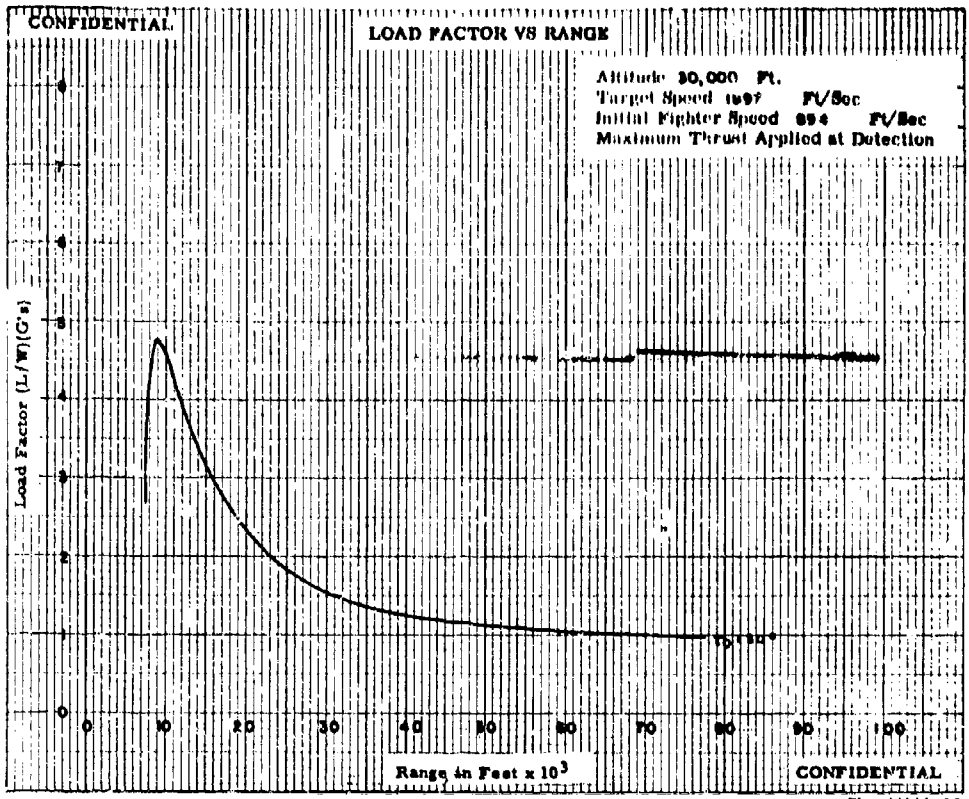


Fig. VIII-11

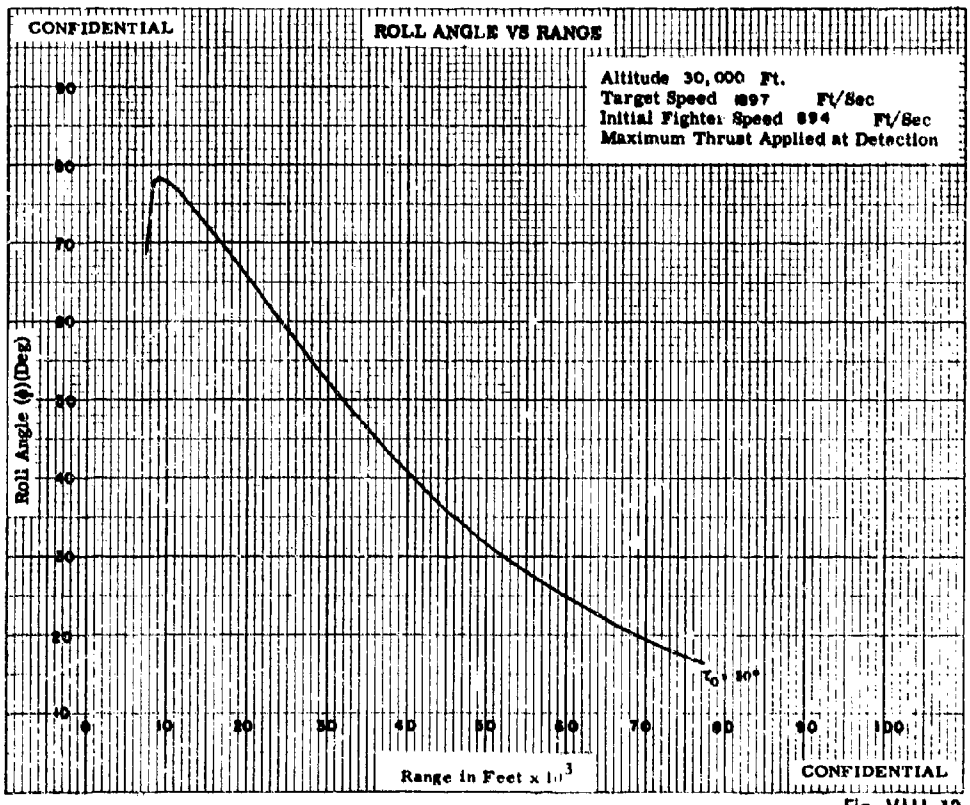


Fig. VIII-12

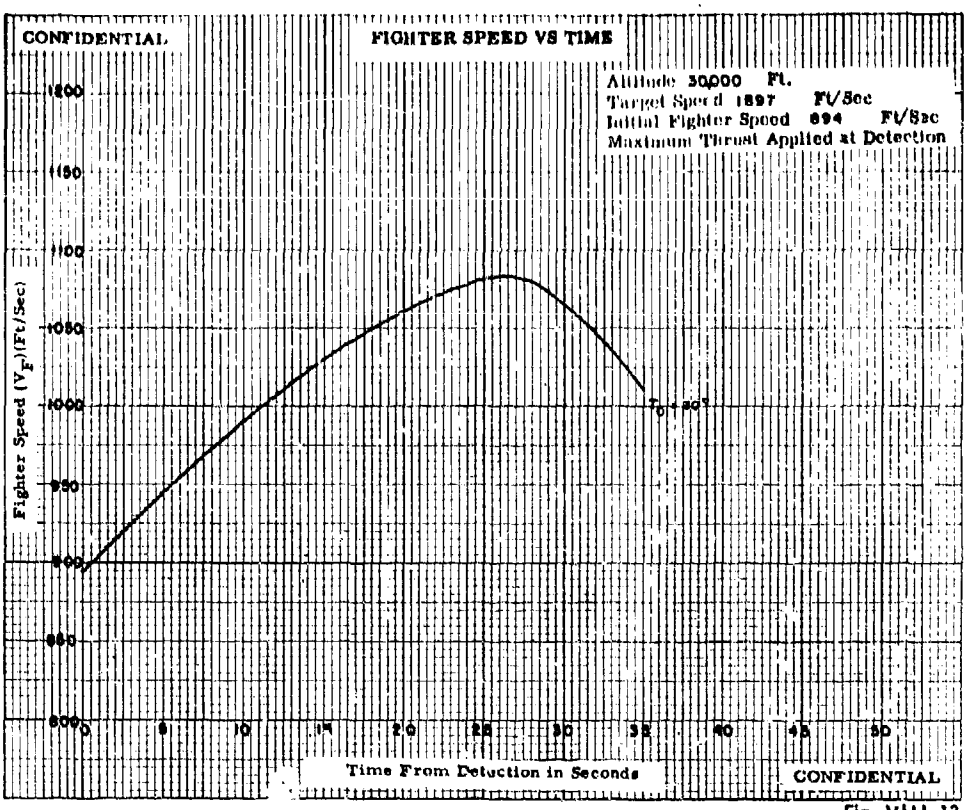


Fig. VIII-13

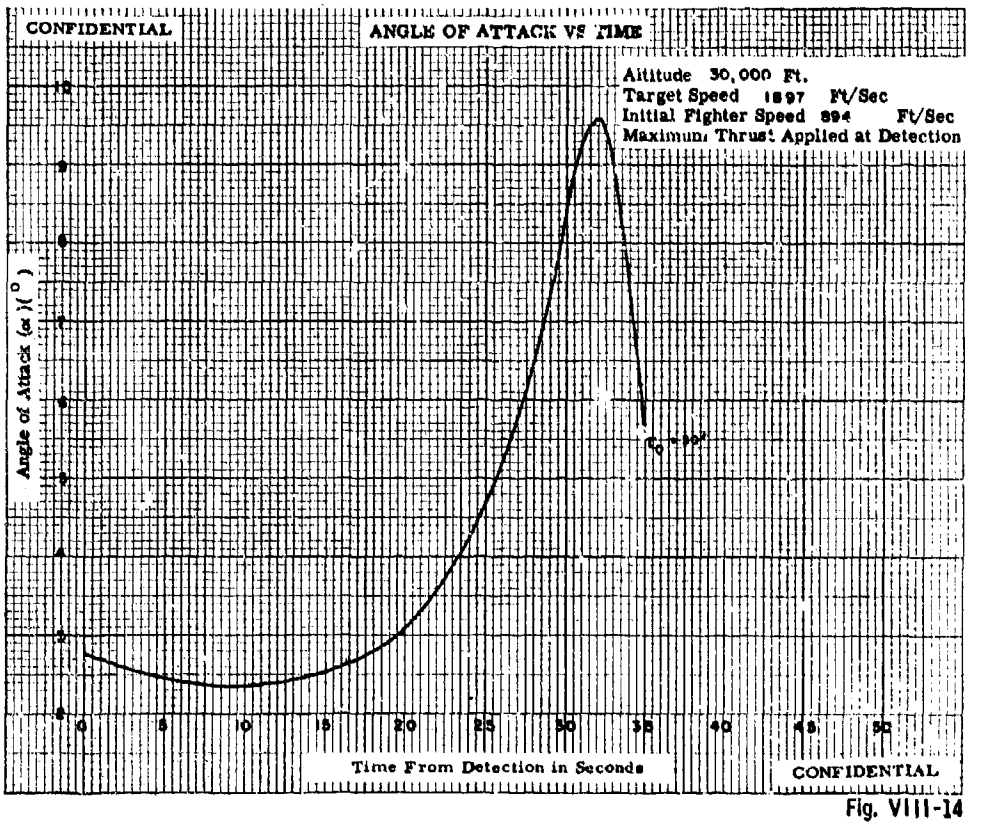
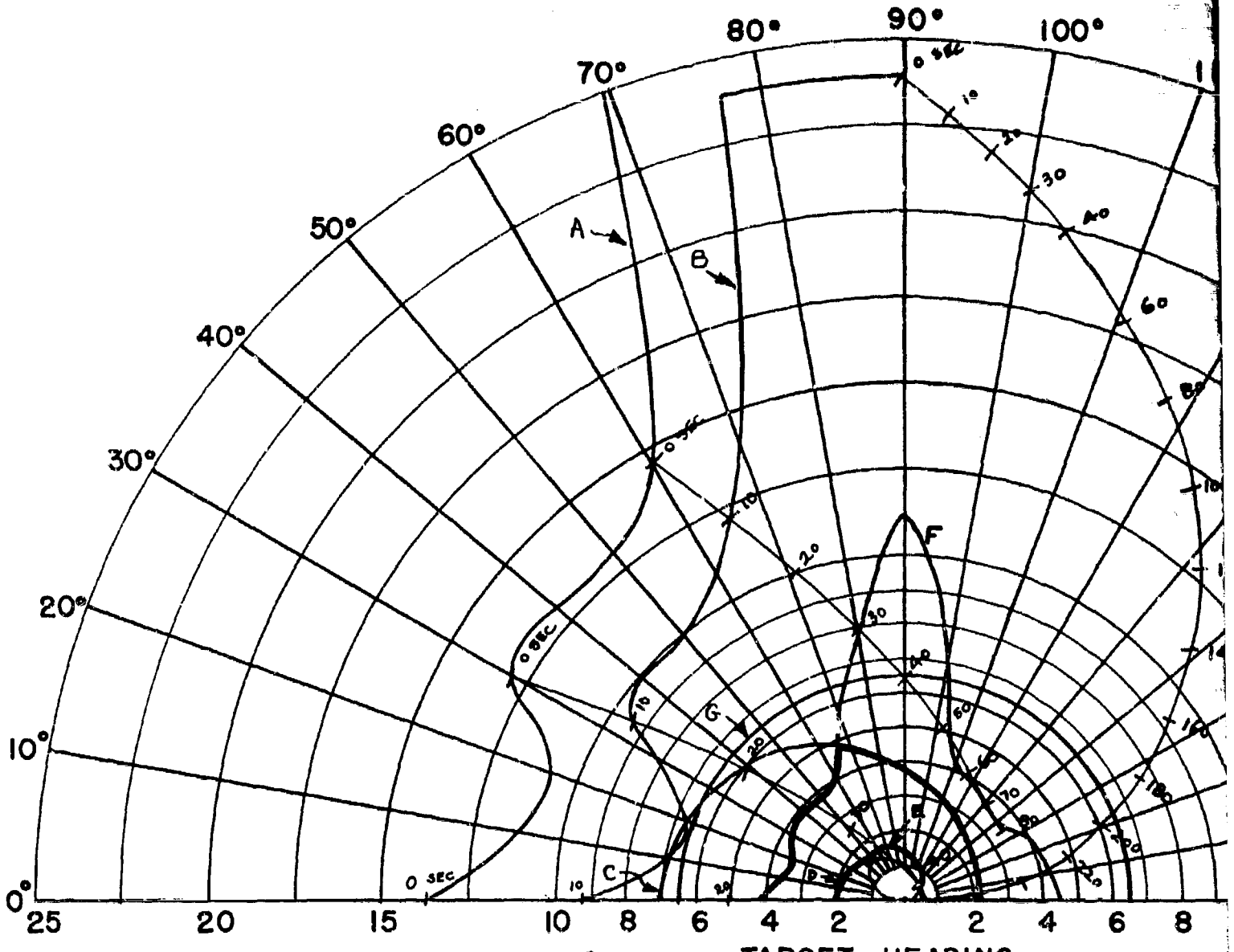


Fig. VIII-14



TARGET HEADING

V_F = 894 FT/SEC (F4H-1)(F8U-3)

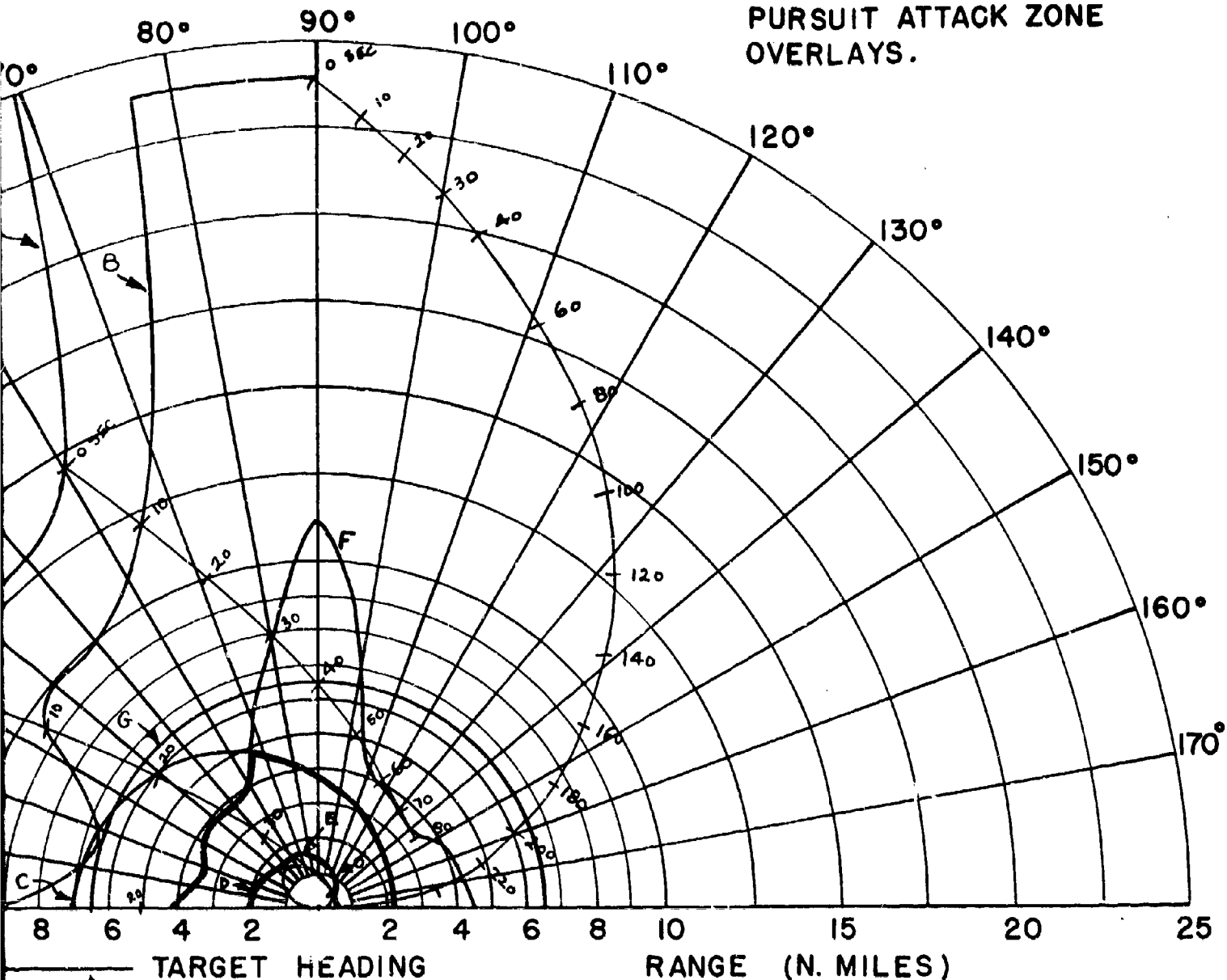
V_T = 1518 FT/SEC

ALTITUDE = 30,000 FT.

INCREASED THRUST AT DETECTION

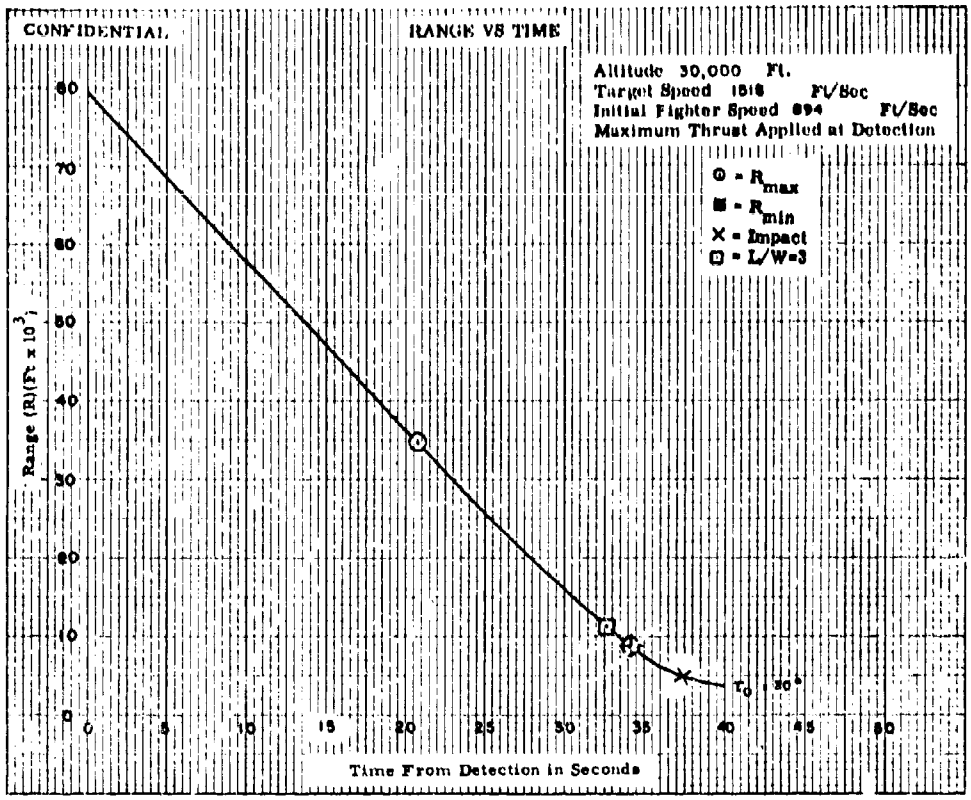
A - 85% DETECTION RANGE
B - LOCK-ON RANGE (10 SEC. LOCK-ON TIME
C - SPARROW III MAX. AERODYNAMIC RANG
D - SPARROW III MIN. AERODYNAMIC RANG
E - CONSTANT LOAD FACTOR LOCUS (N_z =
F - 90% SPARROW III SEEKER LOCK-ON R
G - 6.5 N.M. INTERLOCK

FIG. IX - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS.



85% DETECTION RANGE
LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
SPARROW III MAX. AERODYNAMIC RANGE
SPARROW III MIN. AERODYNAMIC RANGE
CONSTANT LOAD FACTOR LOCUS ($N_Z = 3$)
90% SPARROW III SEEKER LOCK-ON RANGE
6.5 N.M. INTERLOCK

CONFIDENTIAL


CONFIDENTIAL
RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
⊙ = R_{max}
■ = R_{min}
× = Impact
□ = L/W=3
Range (R)(Ft x 10^3)
Time From Detection in Seconds

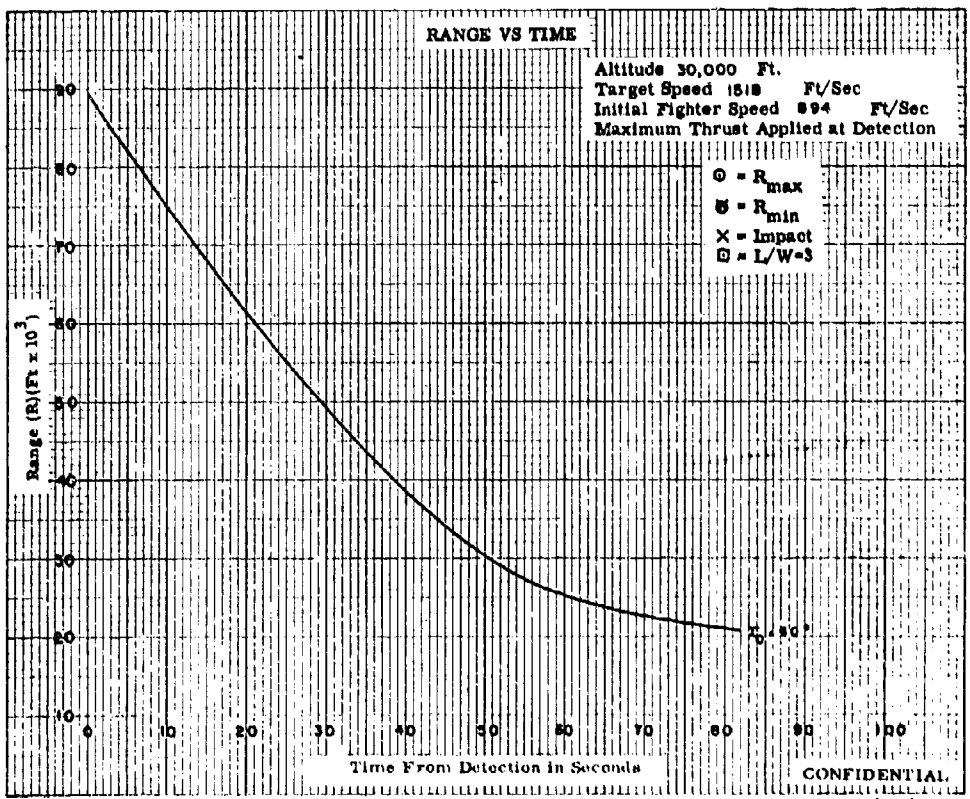

RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
⊙ = R_{max}
■ = R_{min}
× = Impact
□ = L/W=3
Range (R)(Ft x 10^3)
Time From Detection in Seconds
CONFIDENTIAL

Fig. IX-1a

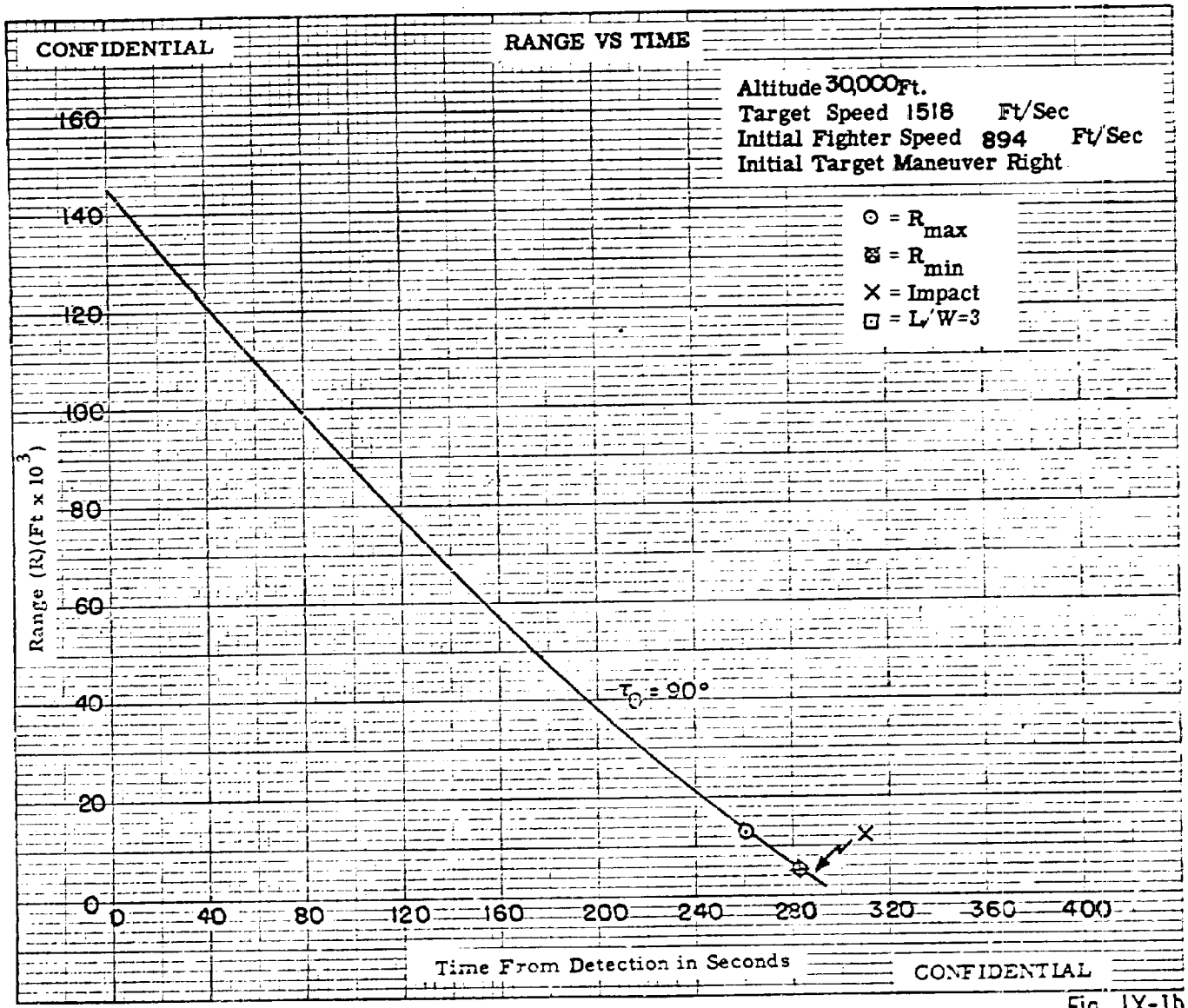
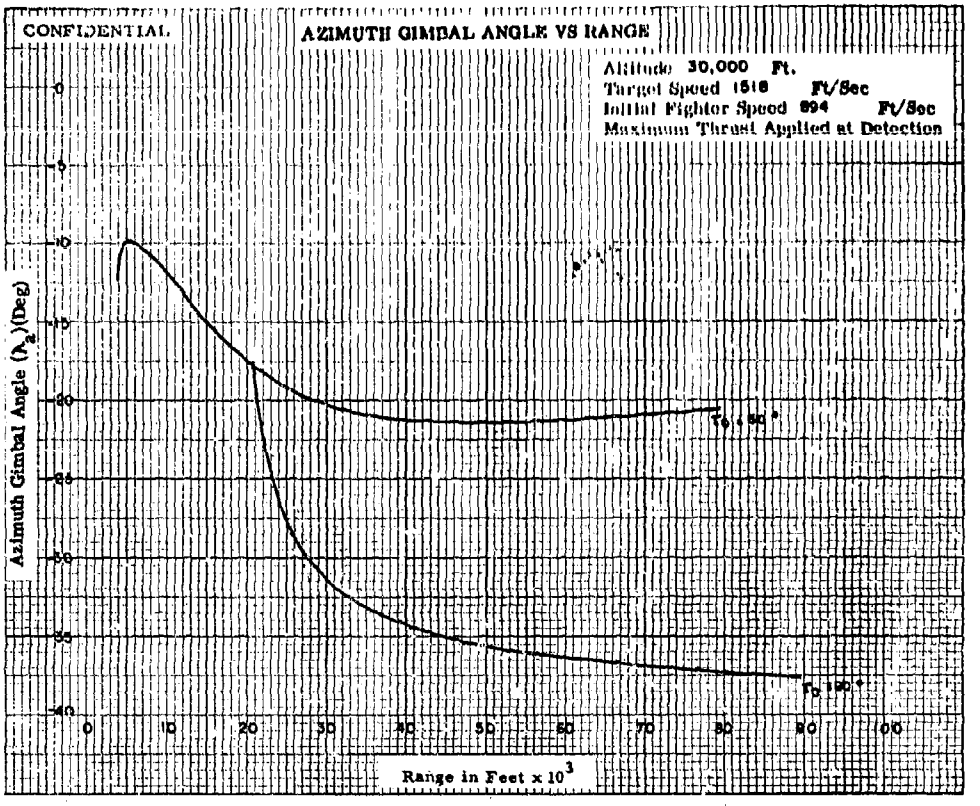

CONFIDENTIAL
RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Initial Target Maneuver Right
⊙ = R_{max}
⊠ = R_{min}
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10^3)
160
140
120
100
80
60
40
20
0
$\tau_{\odot}$ = 90°
X
0
40
80
120
160
200
240
280
320
360
400
Time From Detection in Seconds
CONFIDENTIAL

Fig. IX-1b


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (λ_2)(Deg)
0
-5
-10
-15
-20
-25
-30
-35
-40
T_D 90°
T_D 180°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

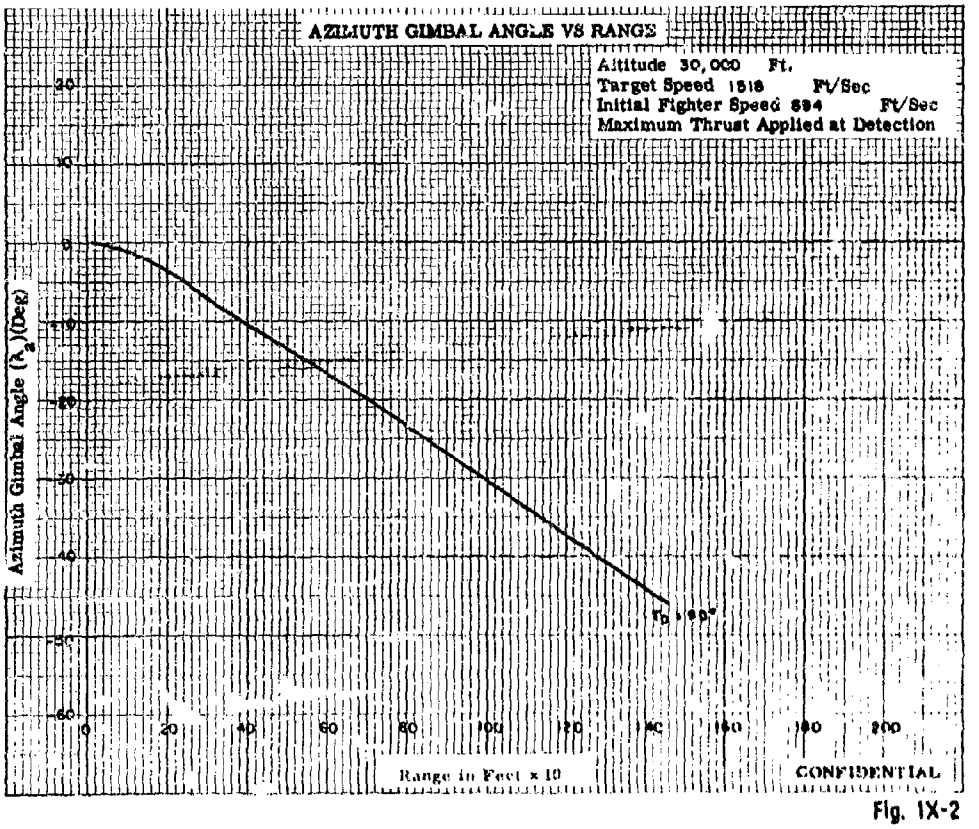
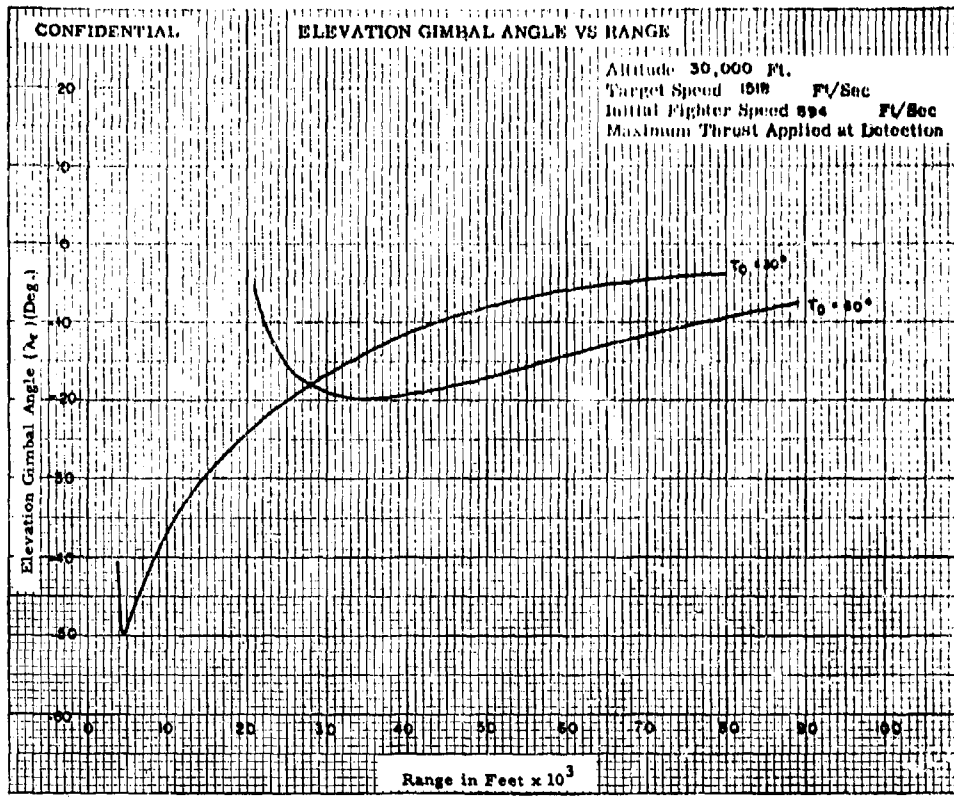

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Gimbal Angle (λ_2)(Deg)
20
10
0
-10
-20
-30
-40
-50
-60
T_D 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10
CONFIDENTIAL

Fig. IX-2


CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Gimbal Angle (λ_E) (Deg.)
20
0
-10
-30
-50
-70
-90
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

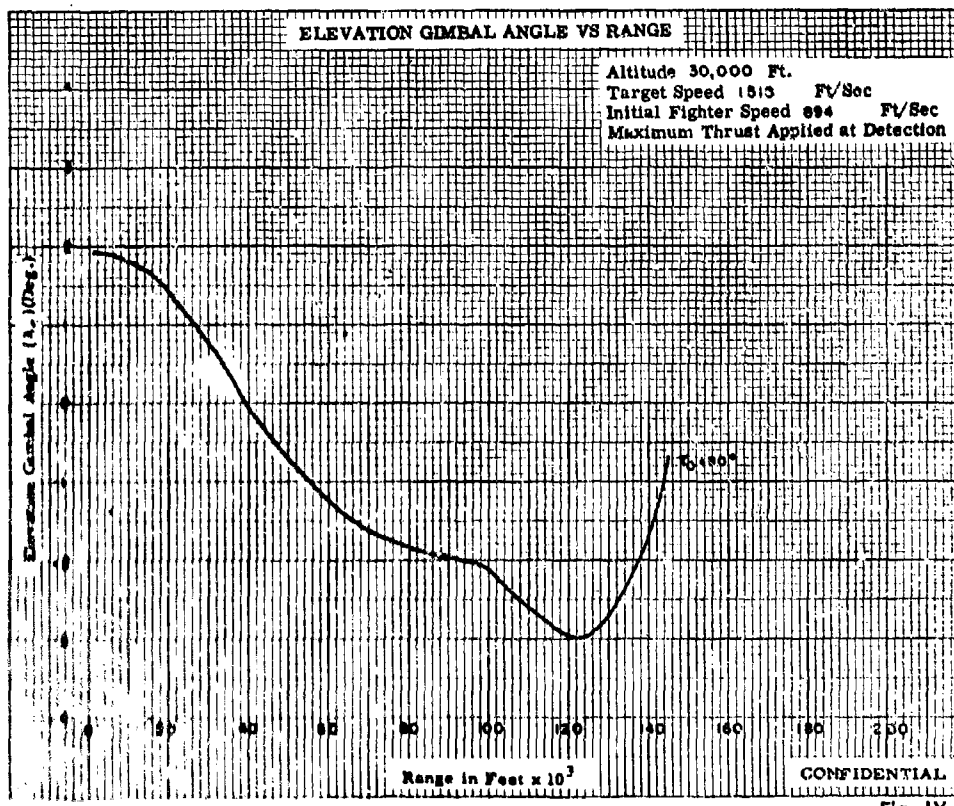

ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Gimbal Angle (λ_E) (Deg.)
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-3

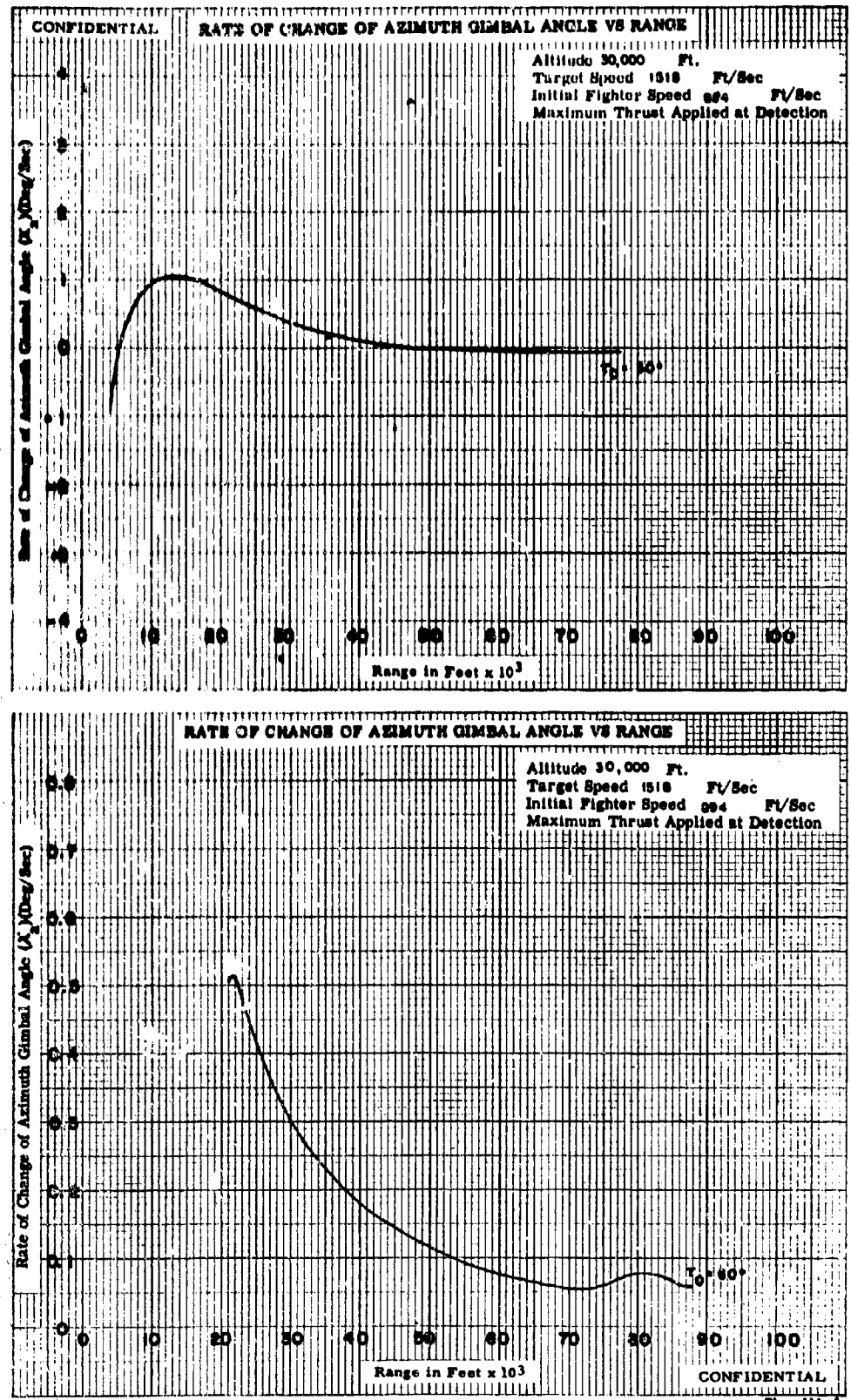

CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
T_0 = 30°
0 10 20 30 40 50 60 70 80 90 100
Range in Feet x 10^3
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
T_0 = 60°
0 10 20 30 40 50 60 70 80 90 100
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-4a

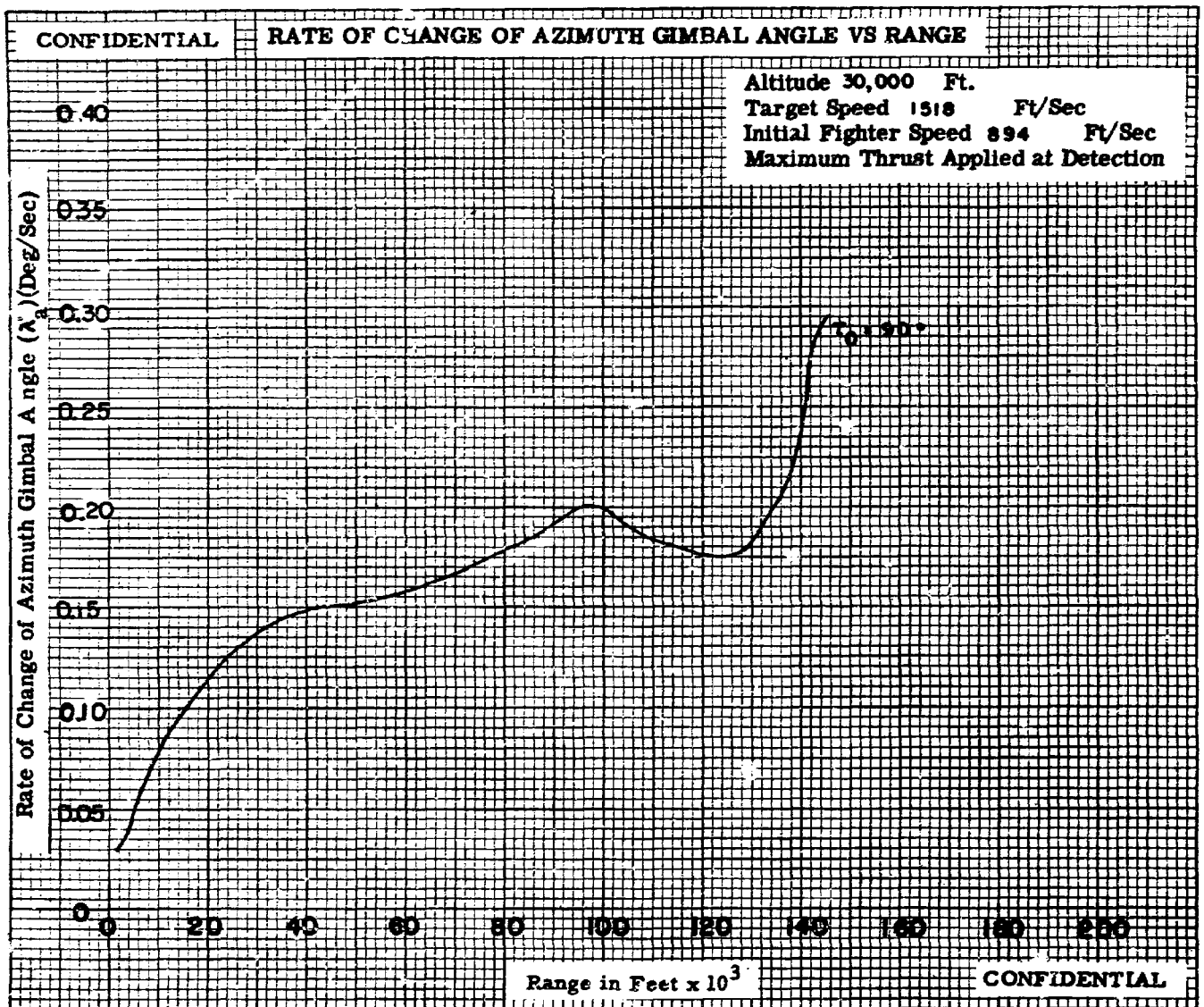
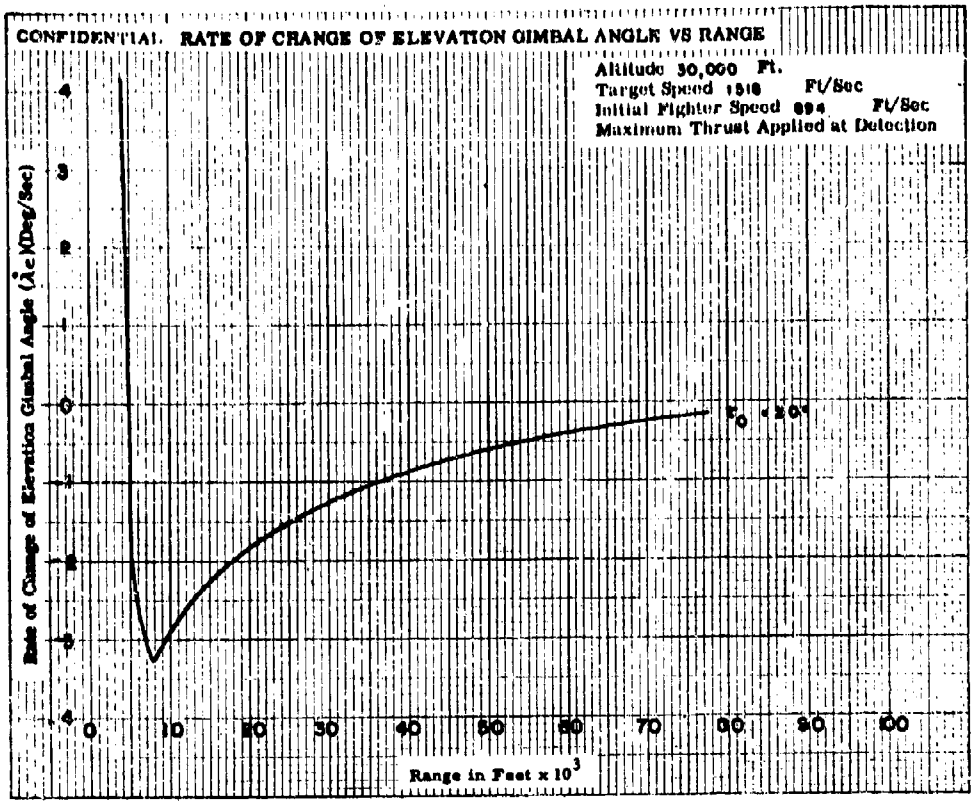

CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Azimuth Gimbal Angle ($\lambda_a^{\cdot}$) (Deg/Sec)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
τ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-4b


CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
Range in Feet x 10^3
0
10
20
30
40
50
60
70
80
90
100

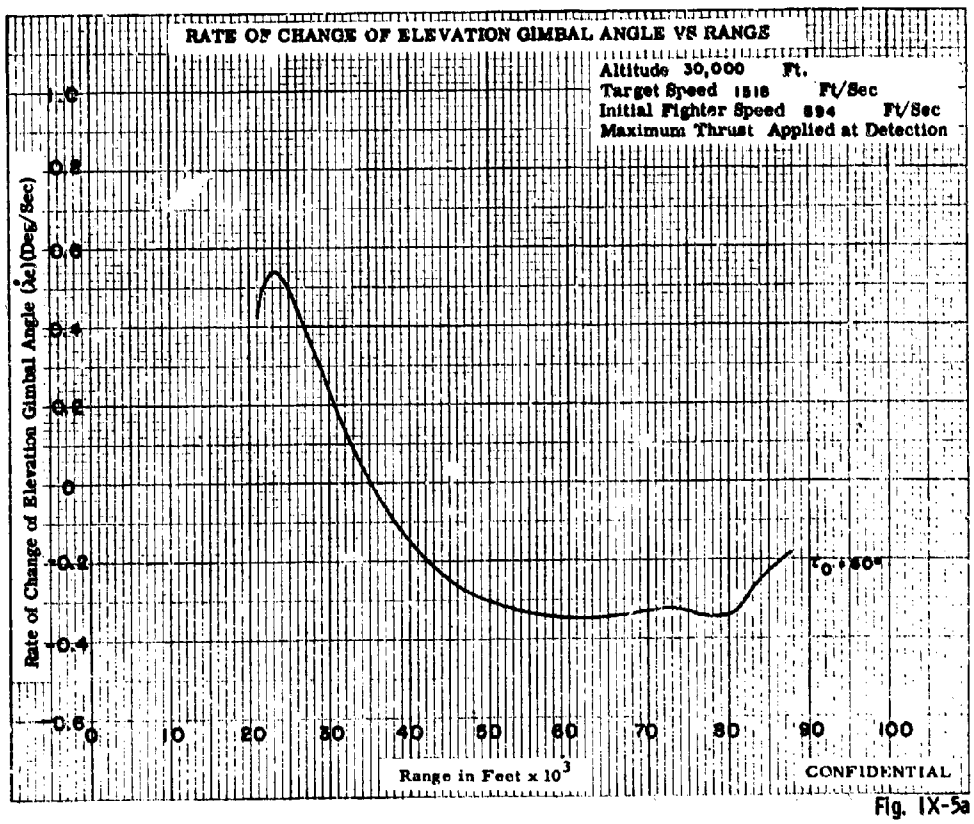

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Range in Feet x 10^3
0
10
20
30
40
50
60
70
80
90
100
CONFIDENTIAL

Fig. IX-5a

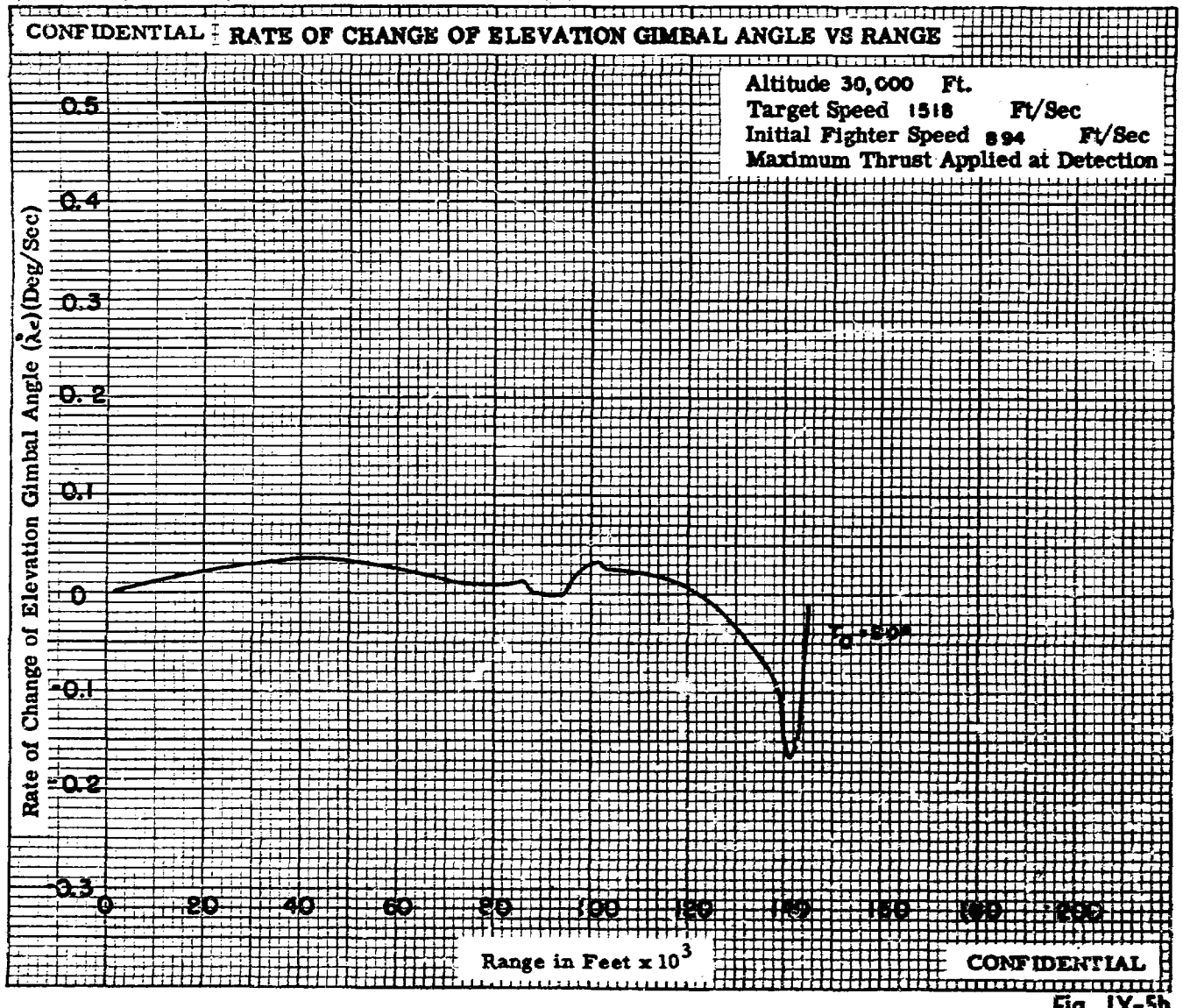
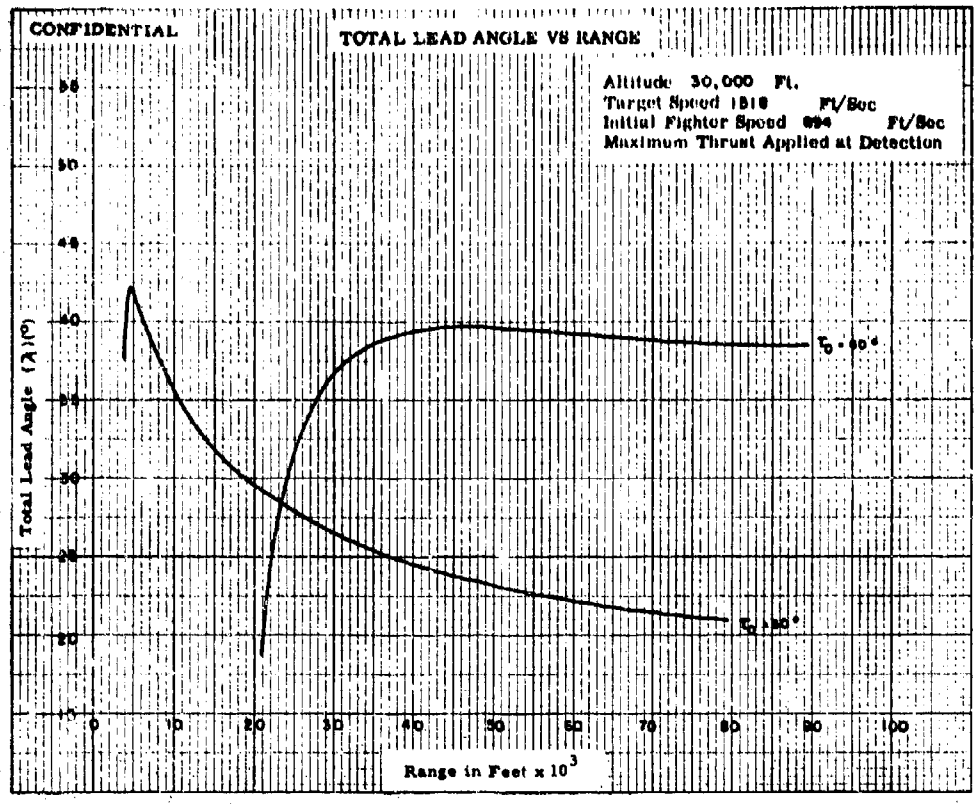

CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Rate of Change of Elevation Gimbal Angle ($\dot{\lambda}_e$)(Deg/Sec)
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
γ_o = 20°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-5b


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Total Lead Angle (λ)(°)
Range in Feet x 10^3

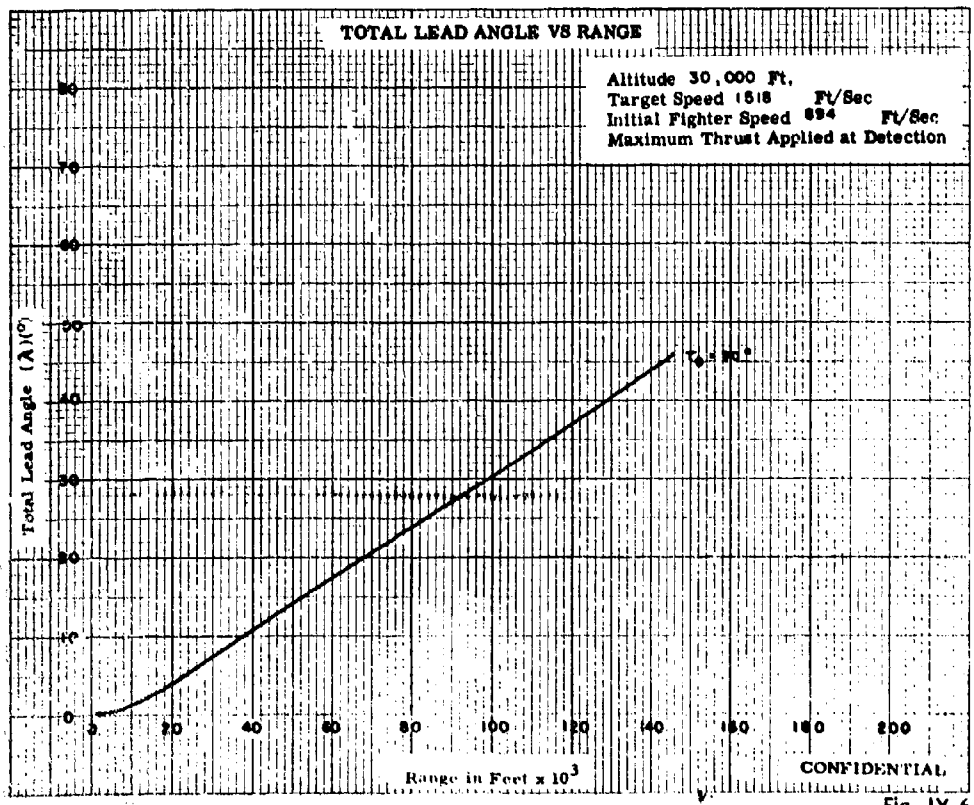
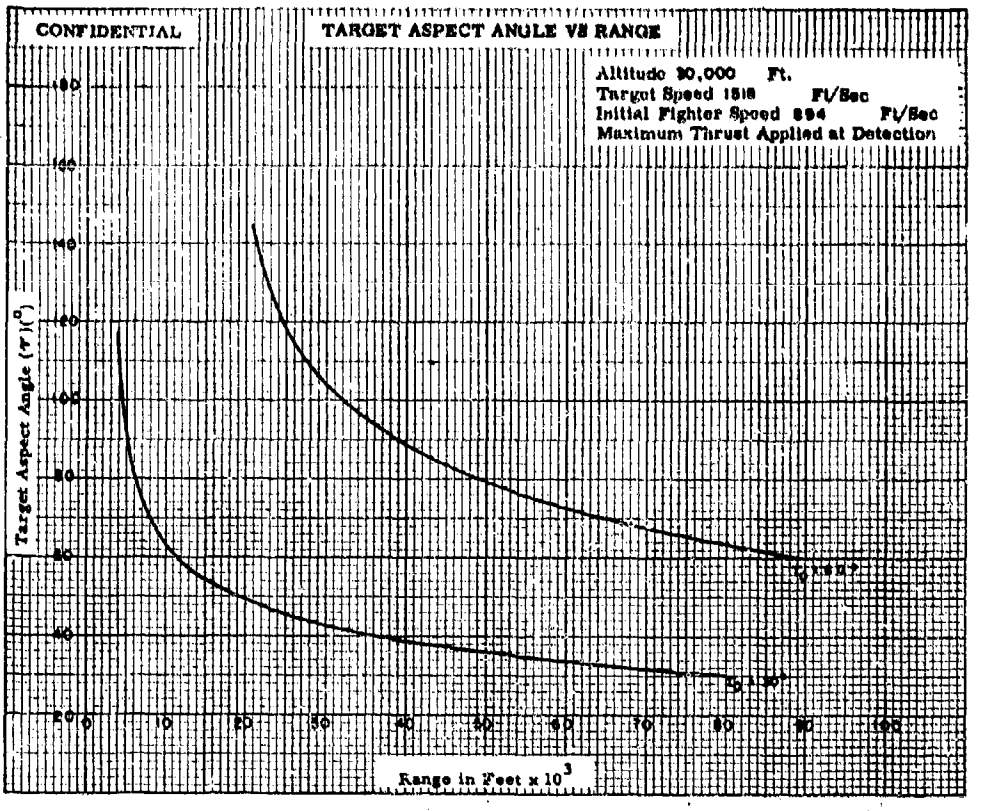

TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Total Lead Angle (λ)(°)
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-6


CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Target Aspect Angle (τ)(°)
180
160
140
120
100
80
60
40
20
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

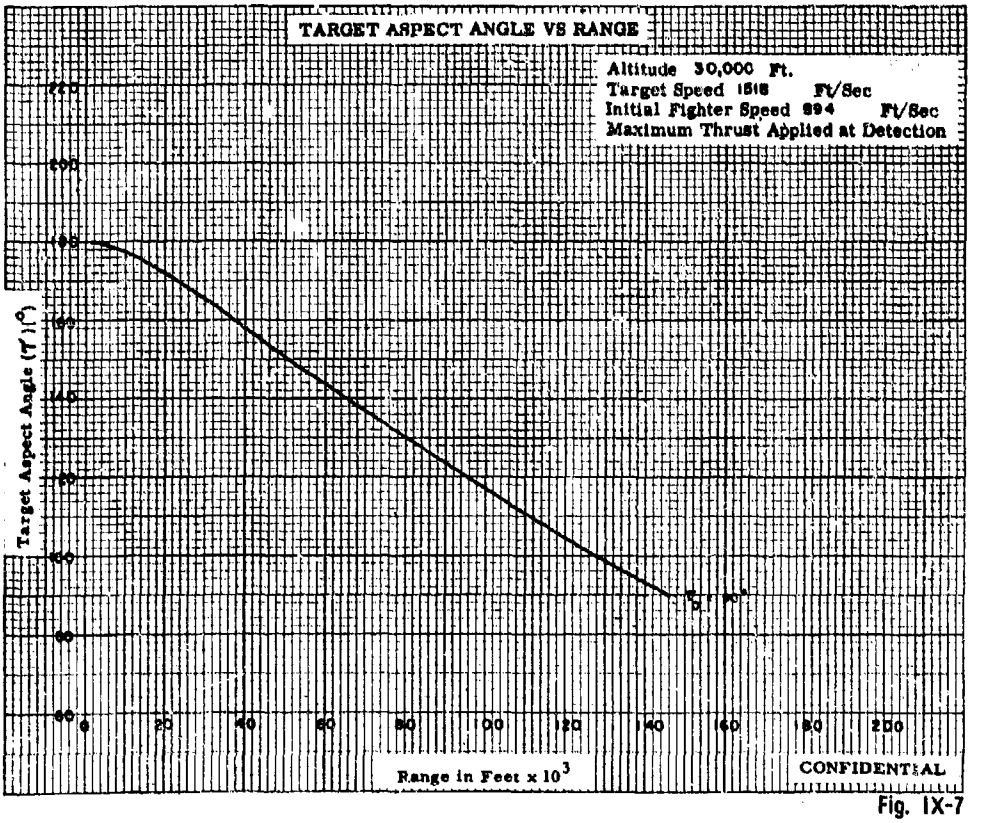
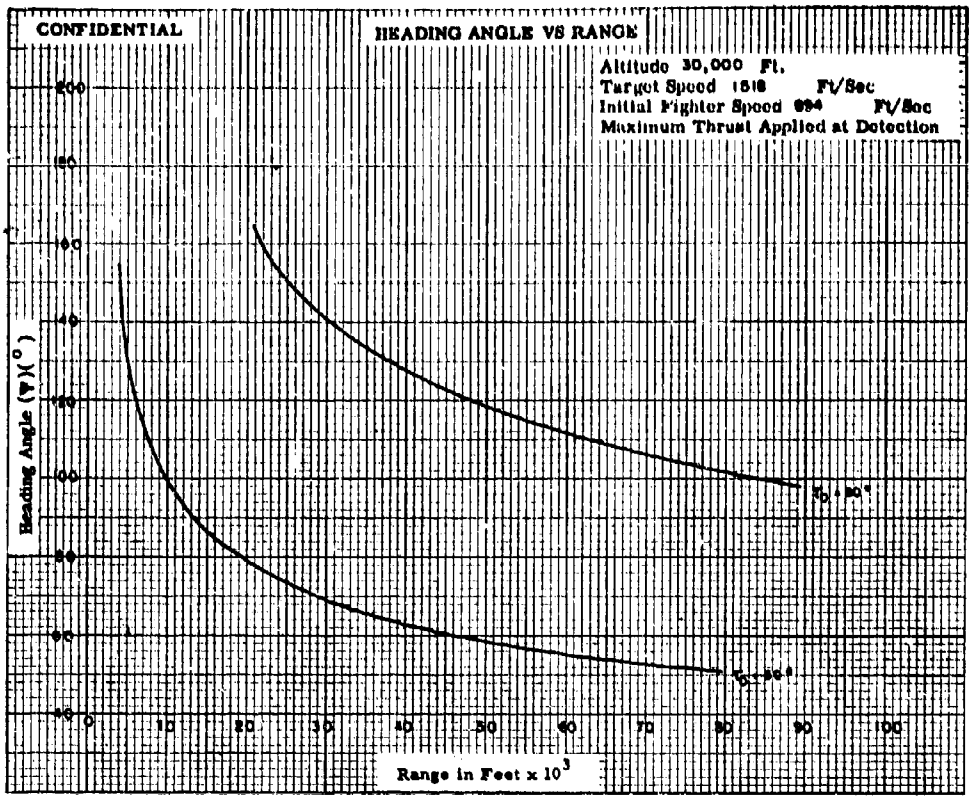

TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Target Aspect Angle (τ)(°)
220
200
180
160
140
120
100
80
60
40
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-7


CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Heading Angle (Ψ)(°)
Range in Feet x 10³

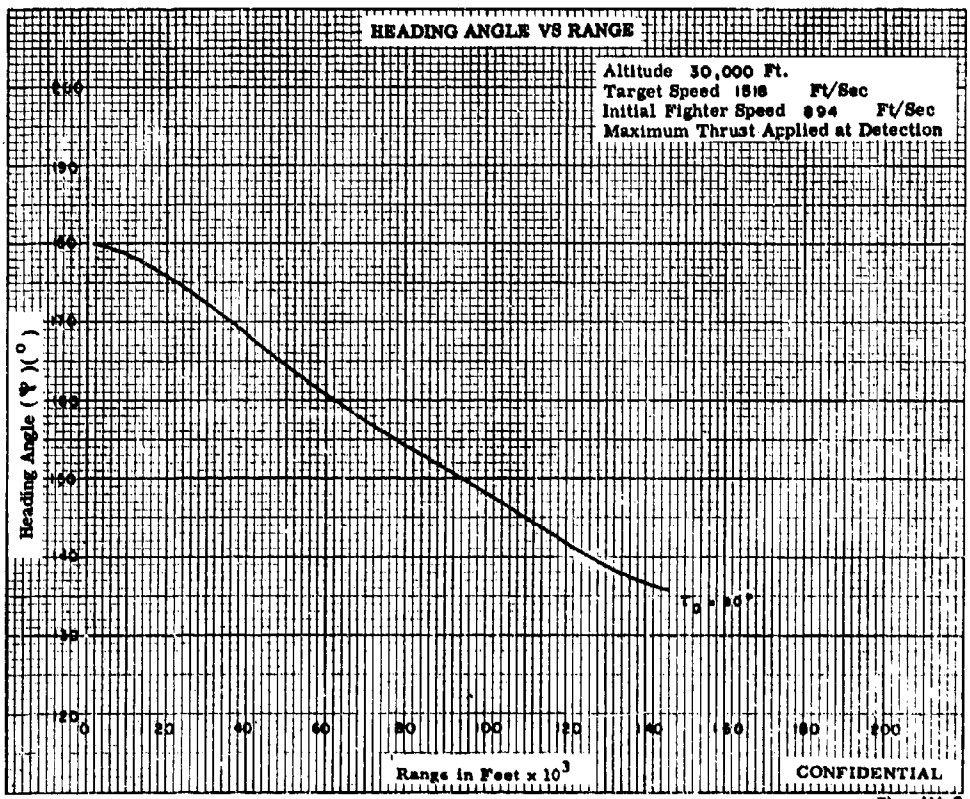
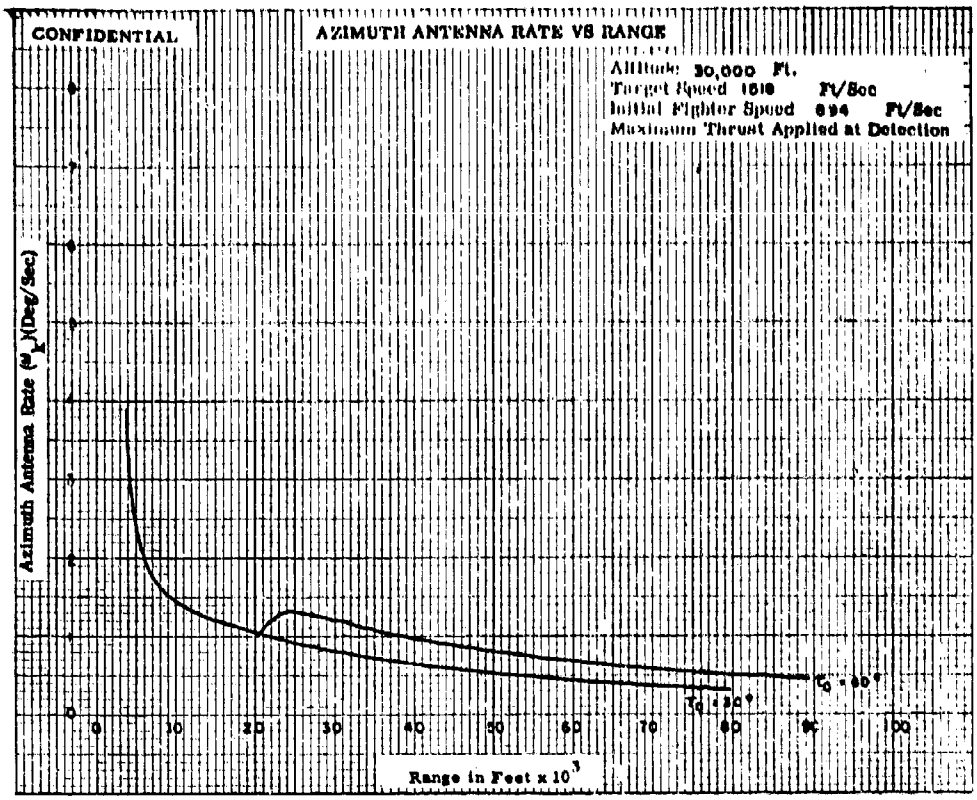

HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Heading Angle (Ψ)(°)
Range in Feet x 10³
CONFIDENTIAL

Fig. IX-8


CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Antenna Rate ($\dot{\sigma}_L$)(Deg/Sec)
σ_0 = 60°
σ_0 = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

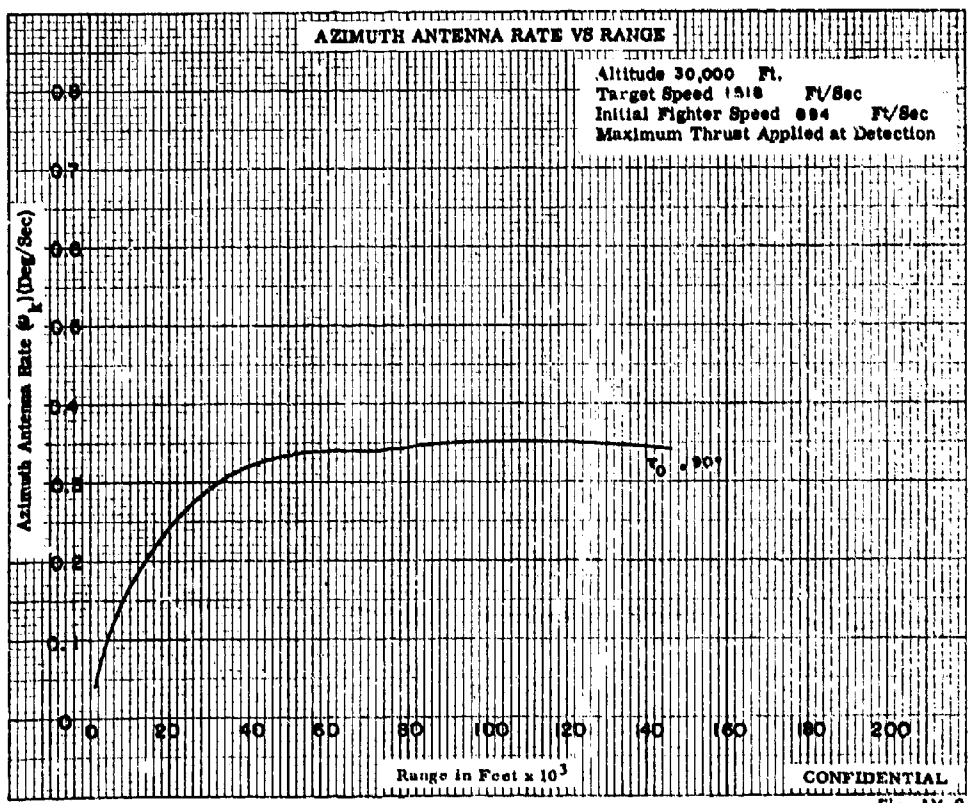
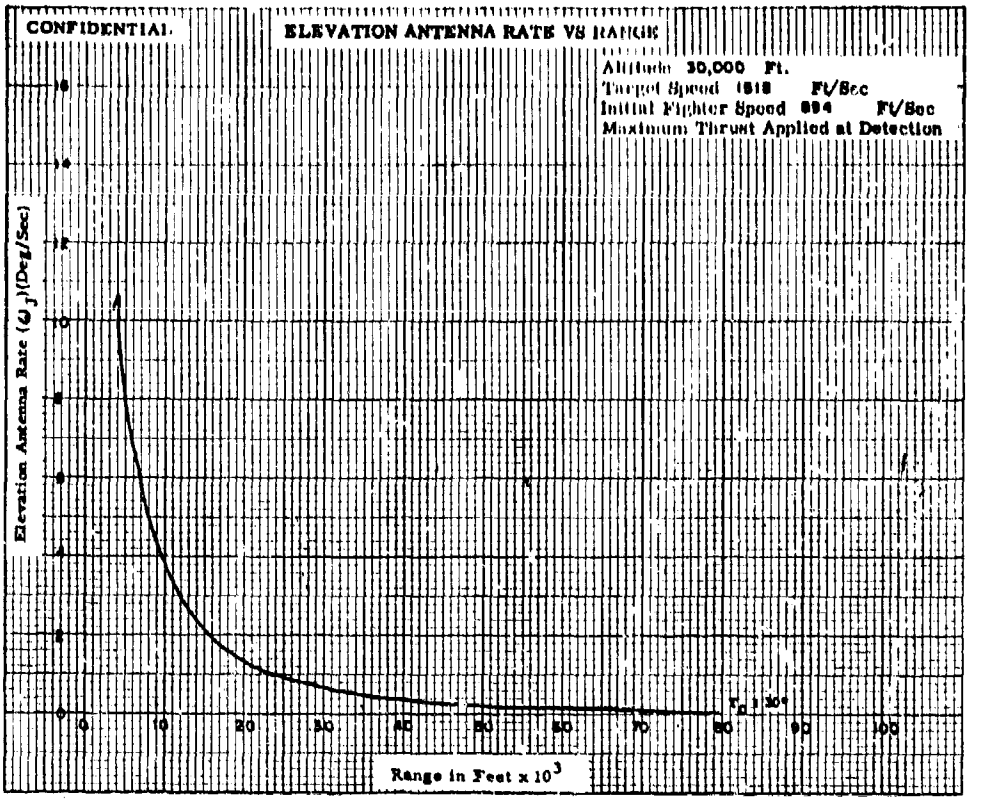

AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Azimuth Antenna Rate ($\dot{\sigma}_L$)(Deg/Sec)
0.9
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
σ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-9


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate (ε̇T)(Deg/Sec)
Range in Feet x 10^3
0
10
20
30
40
50
60
70
80
90
100

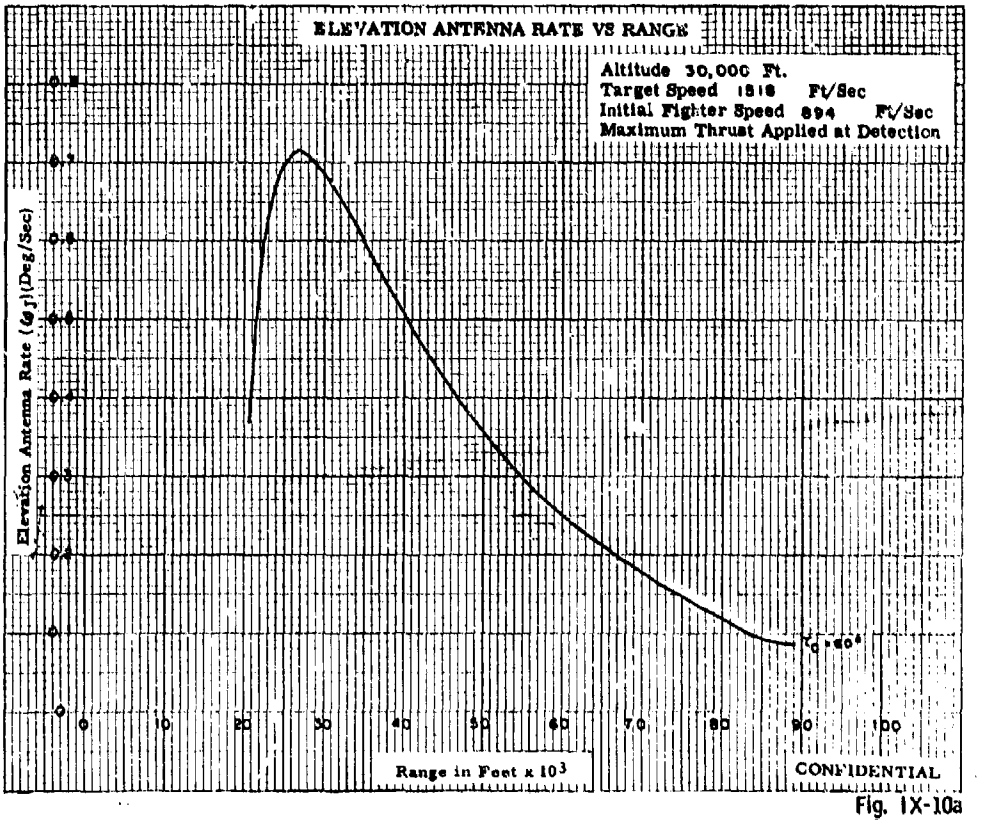

ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate (ε̇T)(Deg/Sec)
Range in Feet x 10^3
0
10
20
30
40
50
60
70
80
90
100
CONFIDENTIAL

Fig. IX-10a

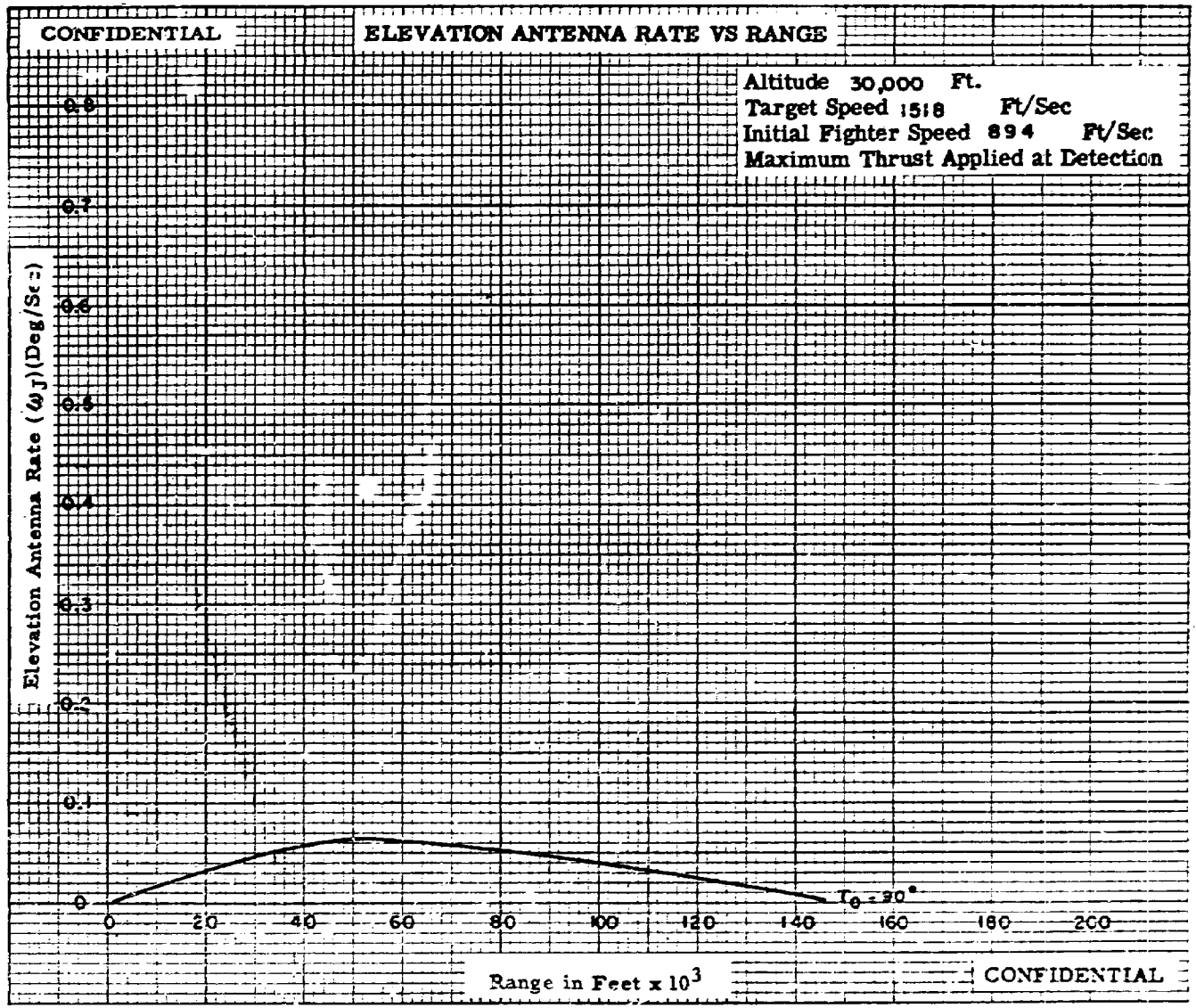
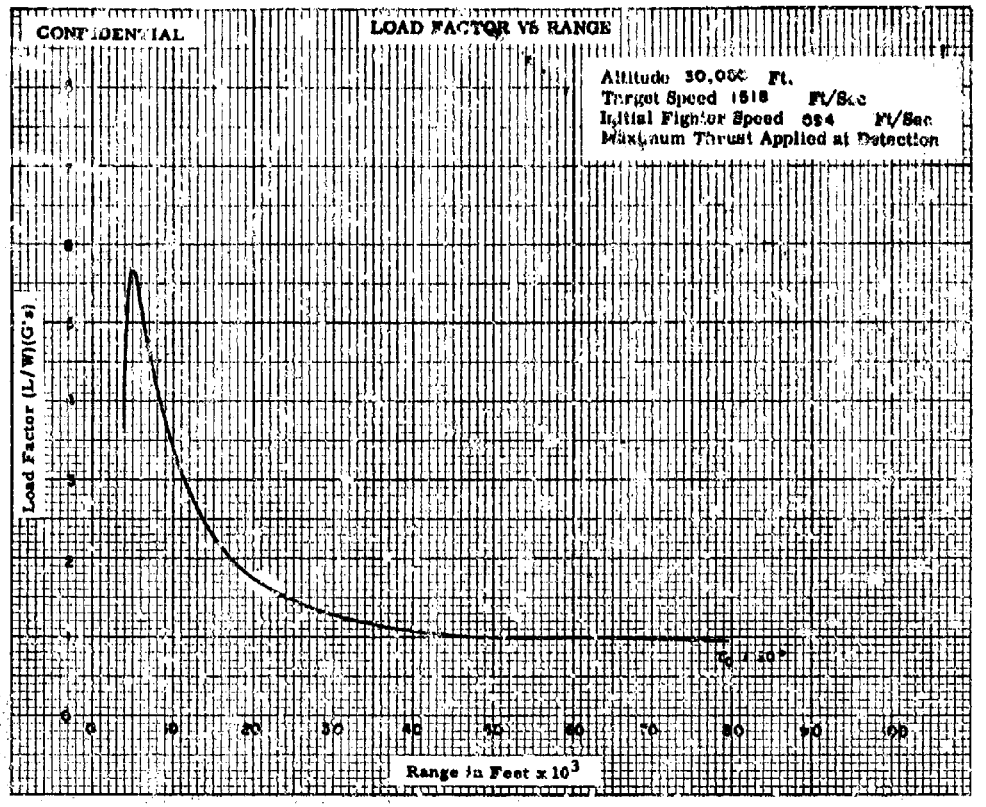

CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Elevation Antenna Rate ($\dot{\epsilon}_T$) (Deg/Sec)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$T_0 = 30°$
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-10b


LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Load Factor (L/W)(G's)
Range in Feet x 10^3
0
10
20
30
40
50
60
70
80
90
100

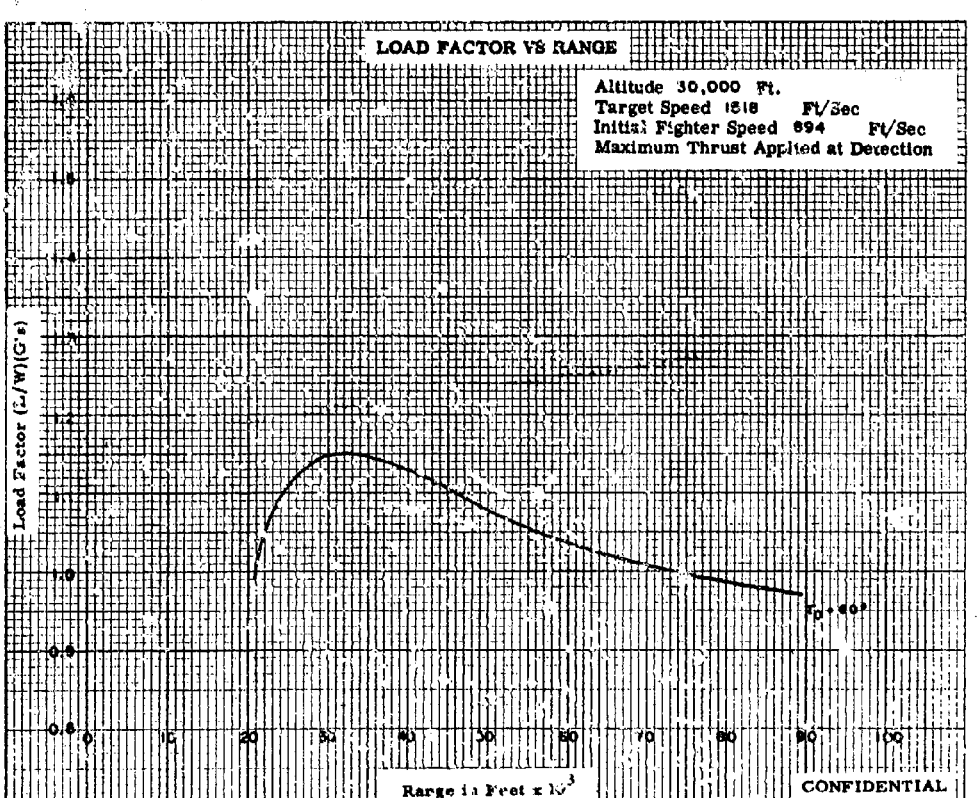

LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Load Factor (L/W)(G's)
1.0
0.0
0
10
20
30
40
50
60
70
80
90
100
CONFIDENTIAL

Fig. IX-11a

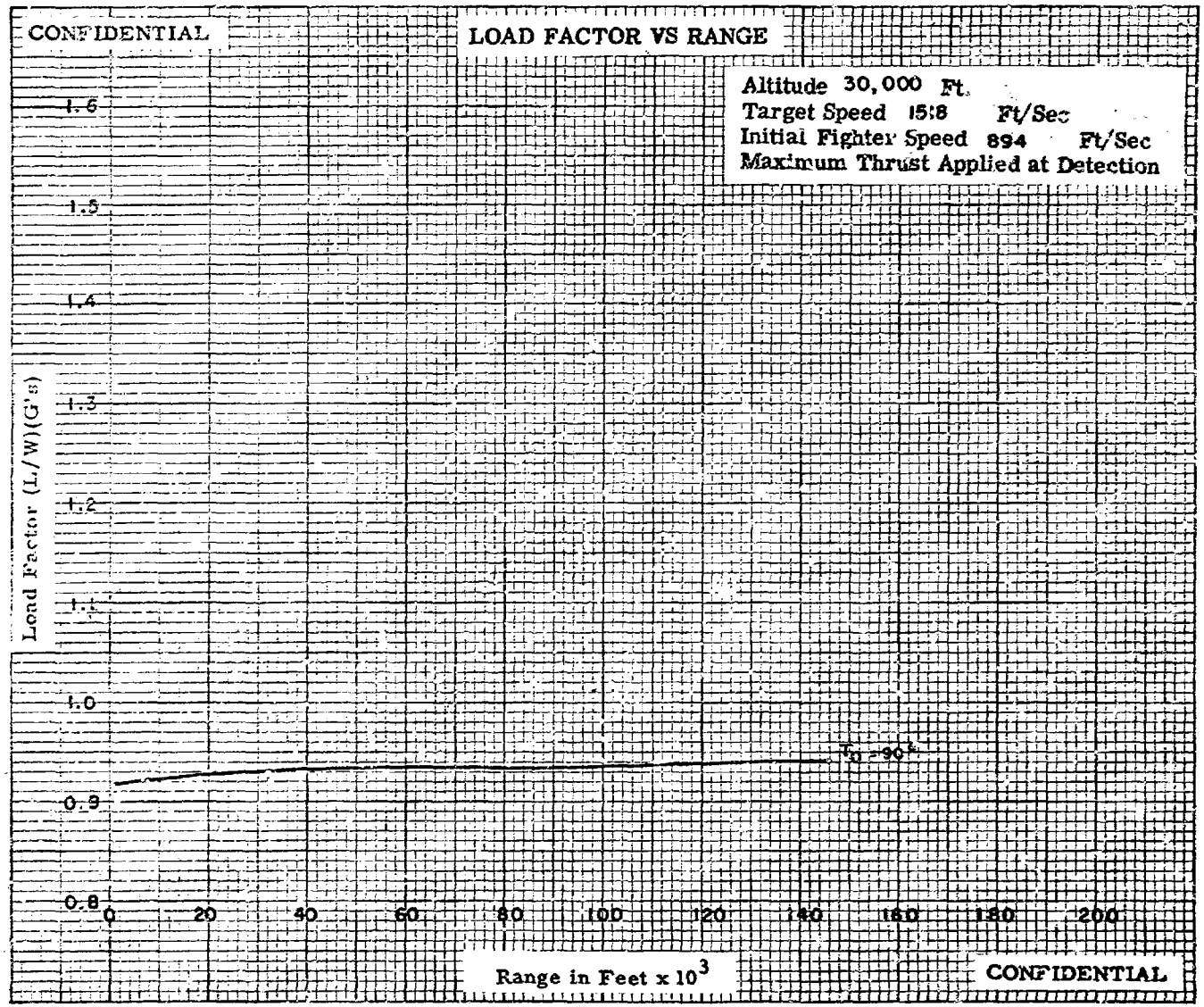
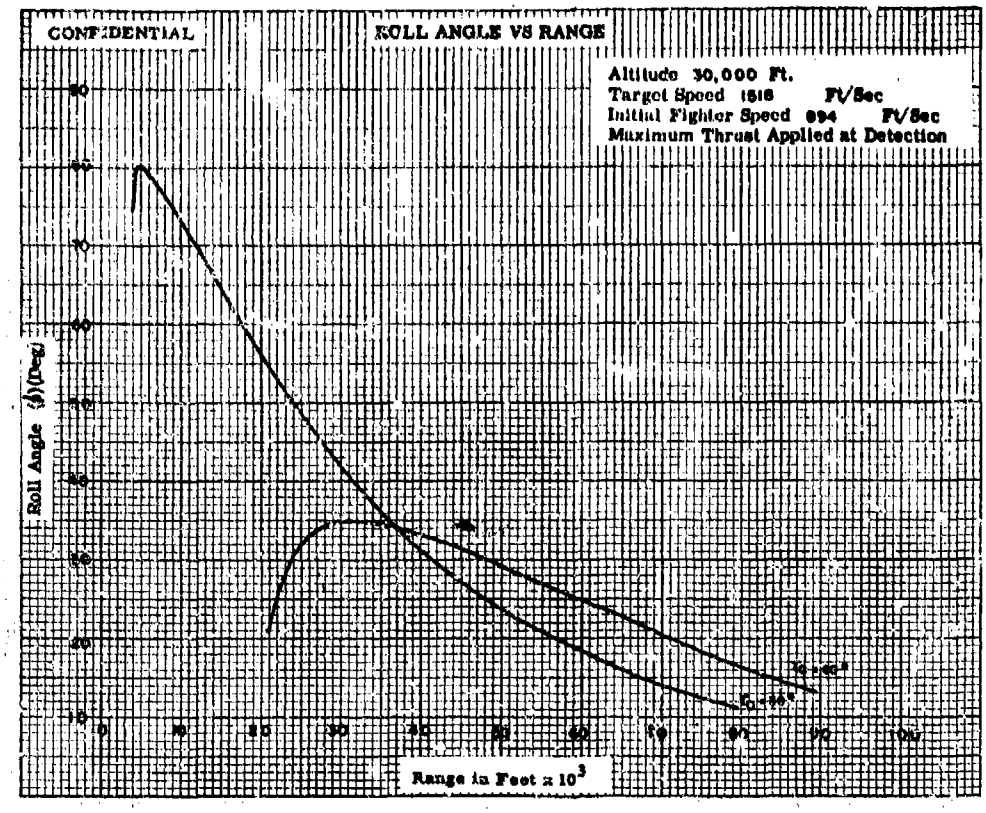

CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Load Factor (L/W)(G's)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
T_D -90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-11b


CONFIDENTIAL
ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Roll Angle (φ)(Deg)
Range in Feet x 10^3

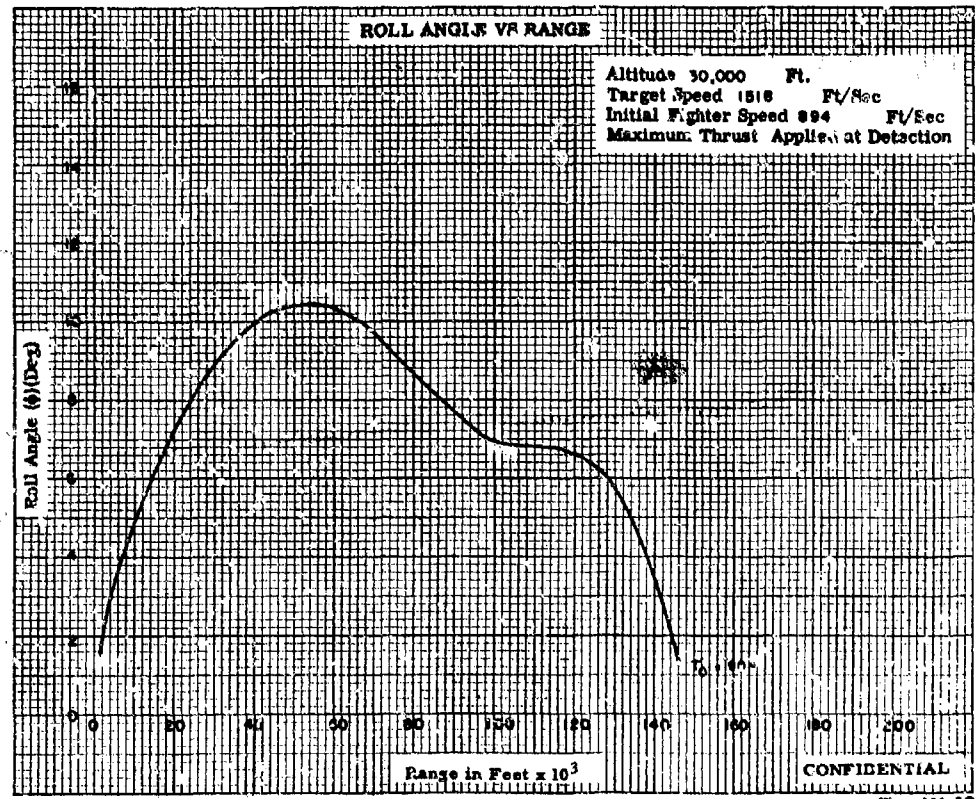
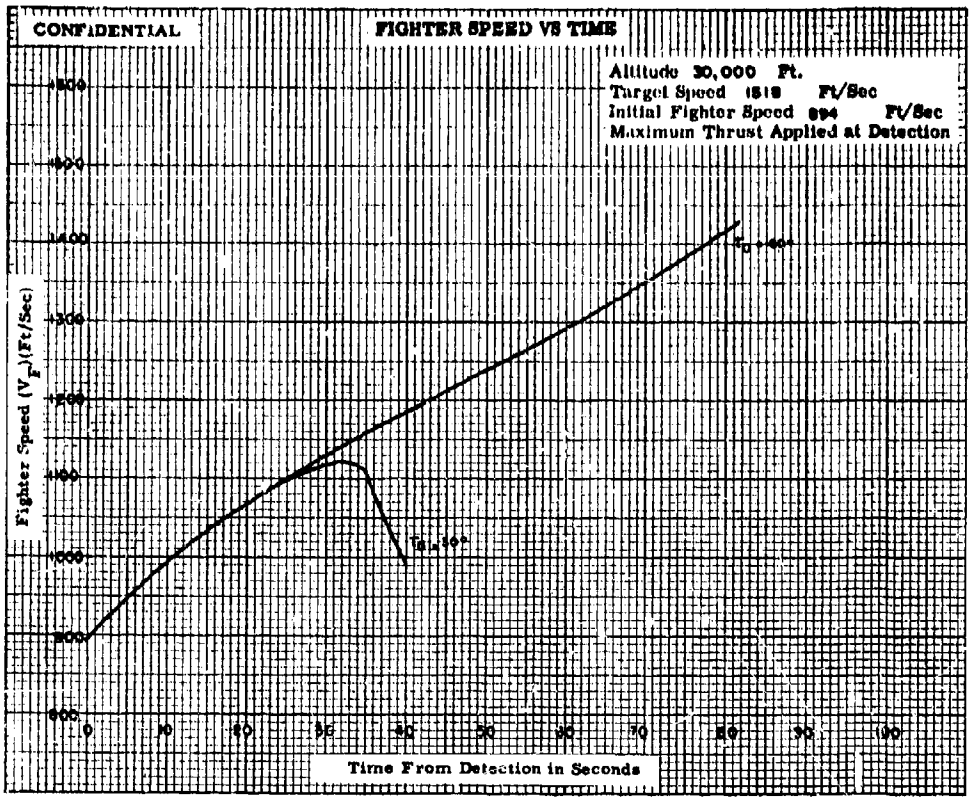

ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Roll Angle (φ)(Deg)
Range in Feet x 10^3
CONFIDENTIAL

Fig. IX-12


CONFIDENTIAL
FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Fighter Speed (V_F)(Ft/Sec)
Time From Detection in Seconds

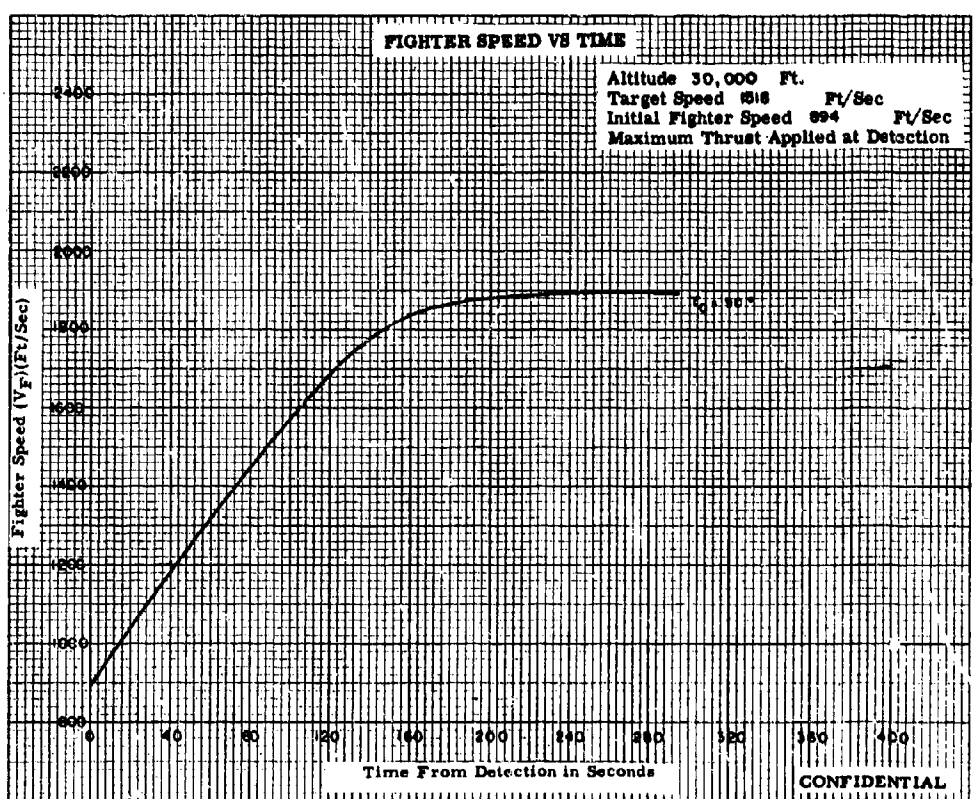

FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Fighter Speed (V_F)(Ft/Sec)
Time From Detection in Seconds
CONFIDENTIAL

Fig. IX-13

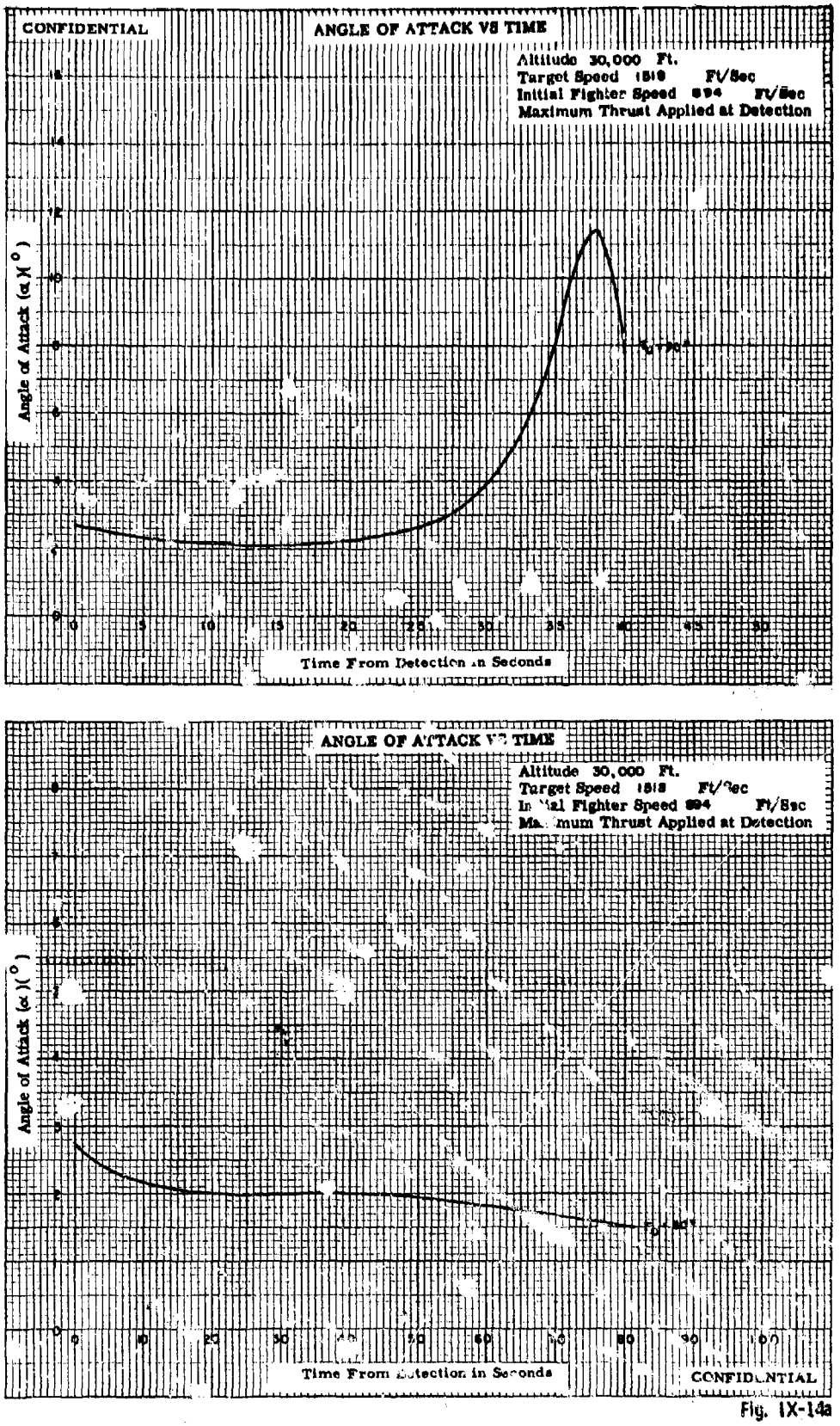

CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Angle of Attack (α)(°)
Time From Detection in Seconds
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Angle of Attack (α)(°)
Time From Detection in Seconds
CONFIDENTIAL

Fig. IX-14a

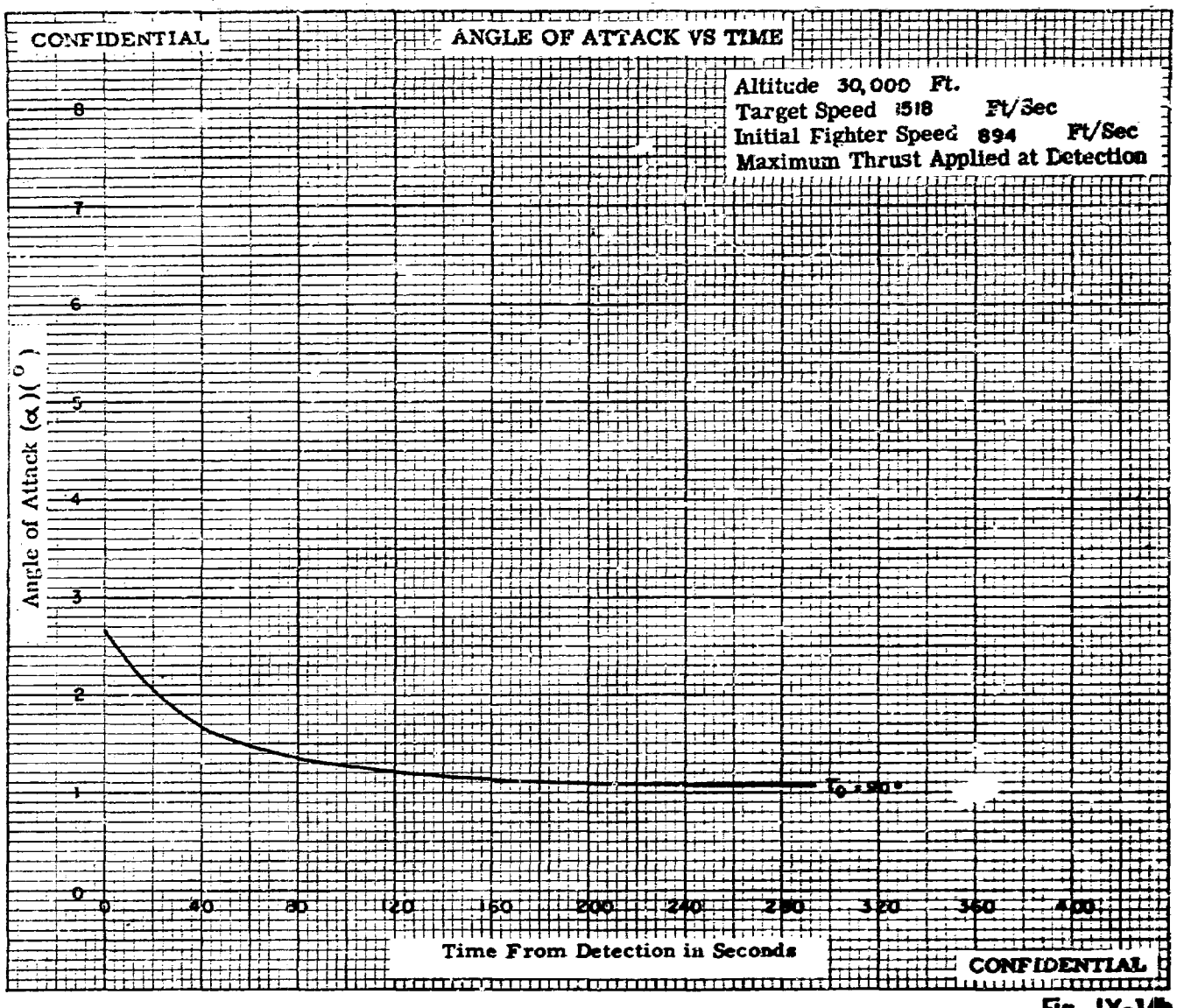
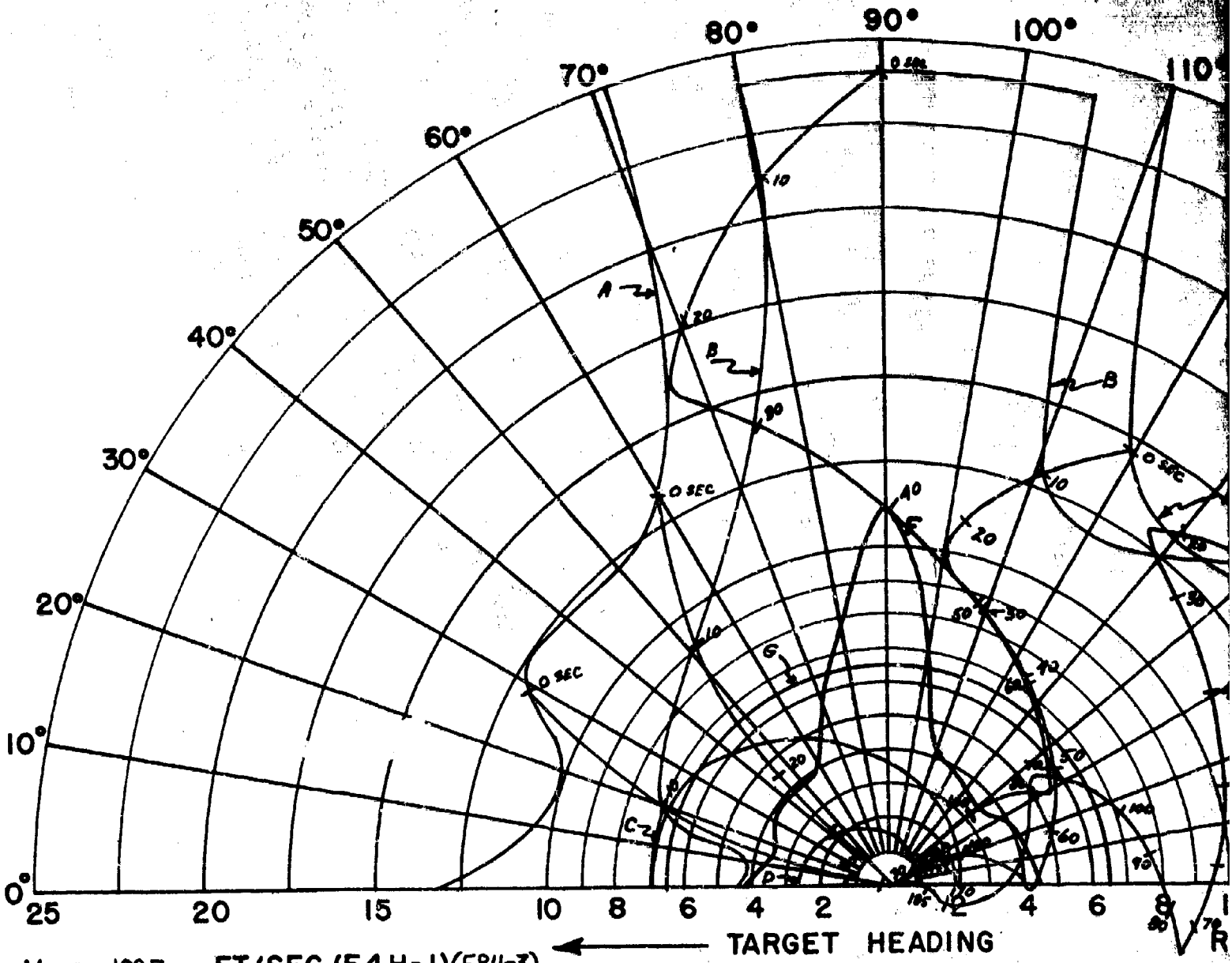

CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 518 Ft/Sec
Initial Fighter Speed 894 Ft/Sec
Maximum Thrust Applied at Detection
Angle of Attack (α)(°)
0
1
2
3
4
5
6
7
8
0
40
80
120
160
200
240
280
320
360
400
Time From Detection in Seconds
CONFIDENTIAL

Fig. IX-14



← TARGET HEADING

V_F = 1897 FT/SEC (F4H-1)(F8U-3)

V_T = 1518 FT/SEC

ALTITUDE = 30,000 FT.

MANEUVERING TARGET—IN TARGET COORDINATES

INITIAL RIGHT TURN

A - 85% DETECTION RANGE

B - LOCK-ON RANGE (10 SEC. LOCK-ON TIME)

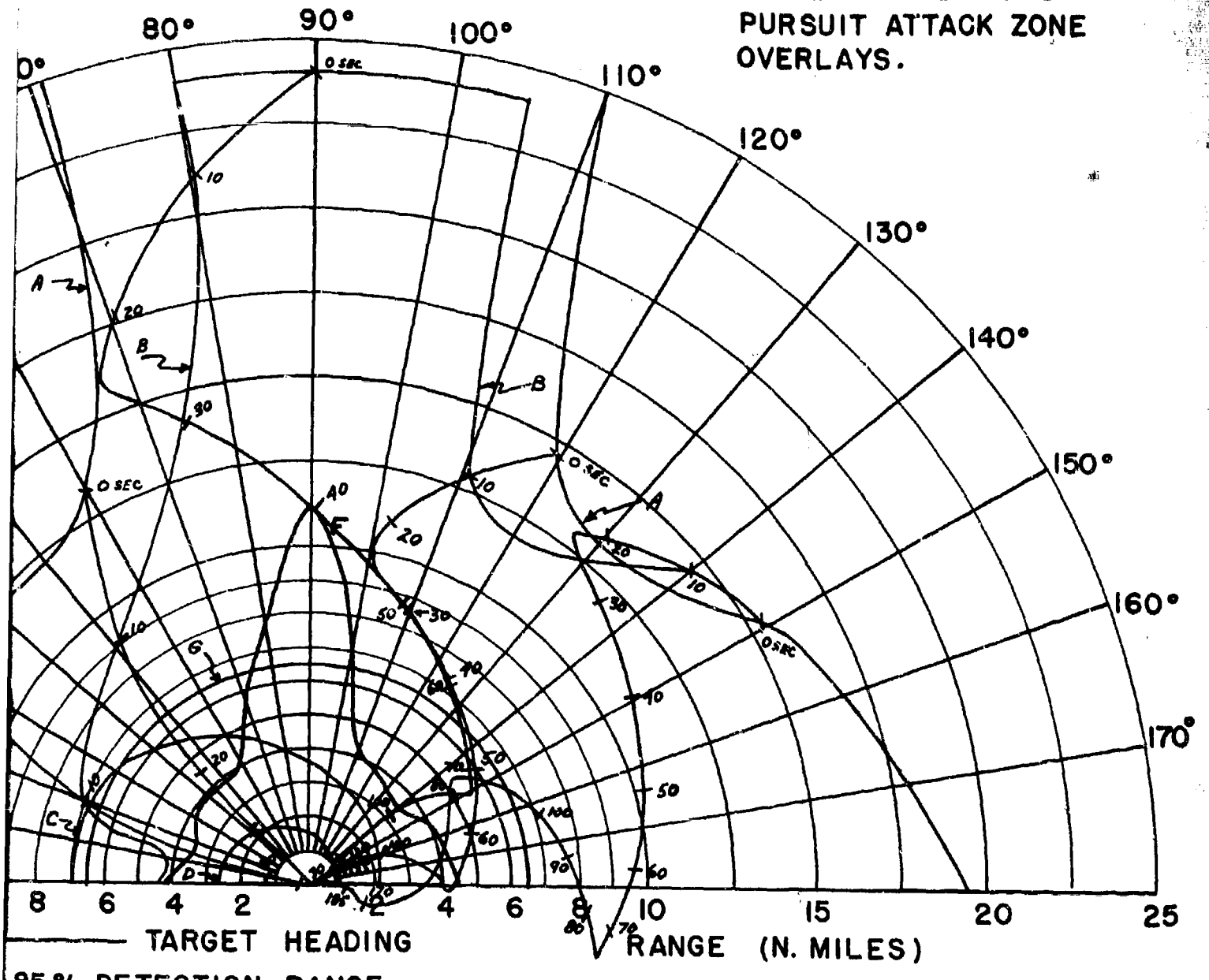
C - SPARROW III MAX. AERODYNAMIC RANGE

D - SPARROW III MIN. AERODYNAMIC RANGE

F - 90% SPARROW III SEEKER LOCK-ON RA

G - 6.5 N.M. INTERLOCK

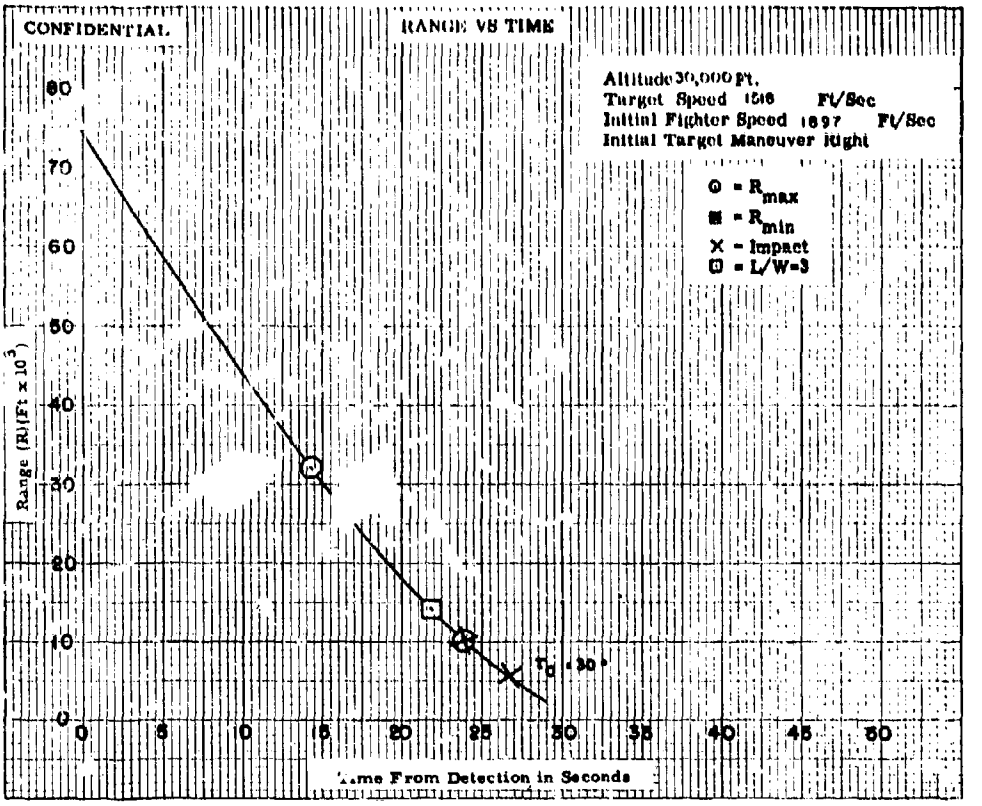
FIG. X - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS.



85% DETECTION RANGE
LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
SPARROW III MAX. AERODYNAMIC RANGE
SPARROW III MIN. AERODYNAMIC RANGE

90% SPARROW III SEEKER LOCK-ON RANGE
6.5 N.M. INTERLOCK

CONFIDENTIAL


CONFIDENTIAL
RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1516 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
⊙ = R_{max}
■ = R_{min}
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10^3)
T_d = 30°
Time From Detection in Seconds

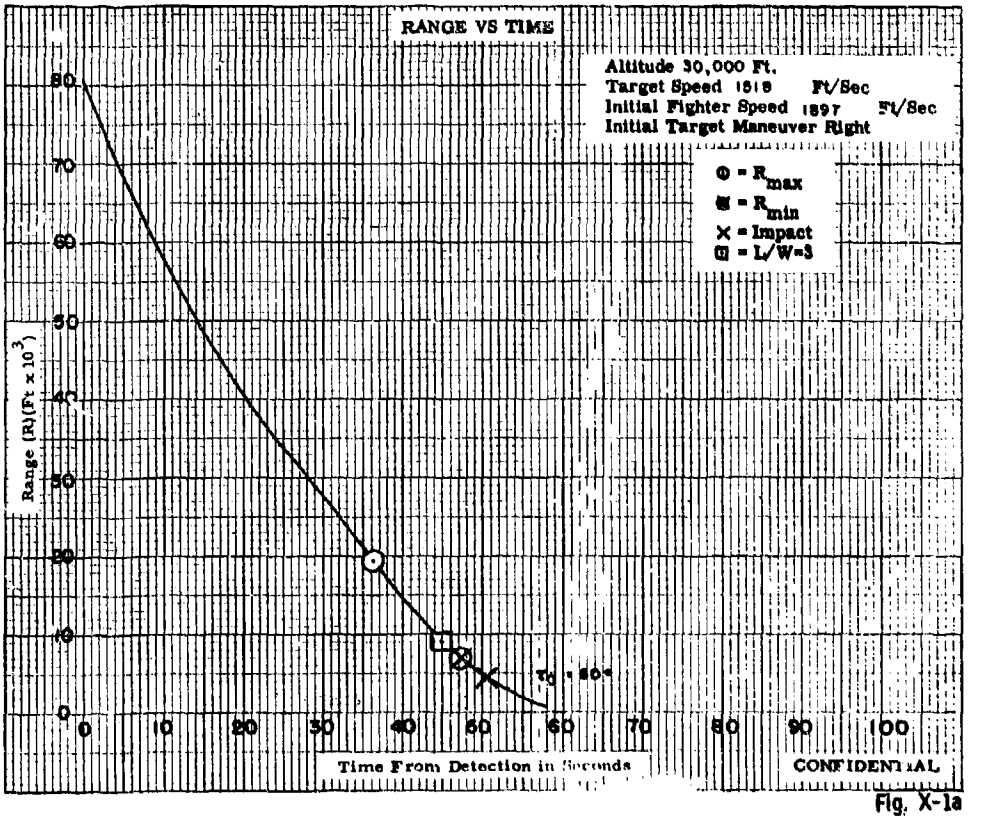
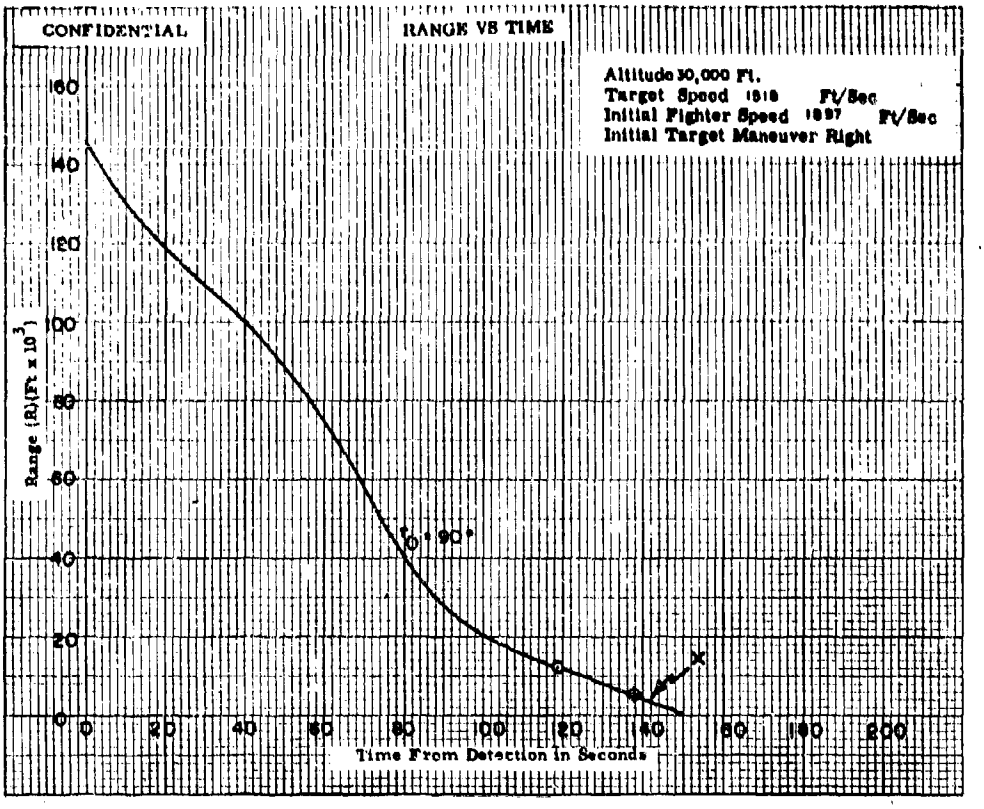

RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1516 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
⊙ = R_{max}
■ = R_{min}
× = Impact
⊡ = L/W=3
Range (R)(Ft x 10^3)
T_d = 60°
Time From Detection in Seconds
CONFIDENTIAL

Fig. X-1a


CONFIDENTIAL
RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Range (R)(Ft x 10³)
160
140
120
100
80
60
40
20
0
ψ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds

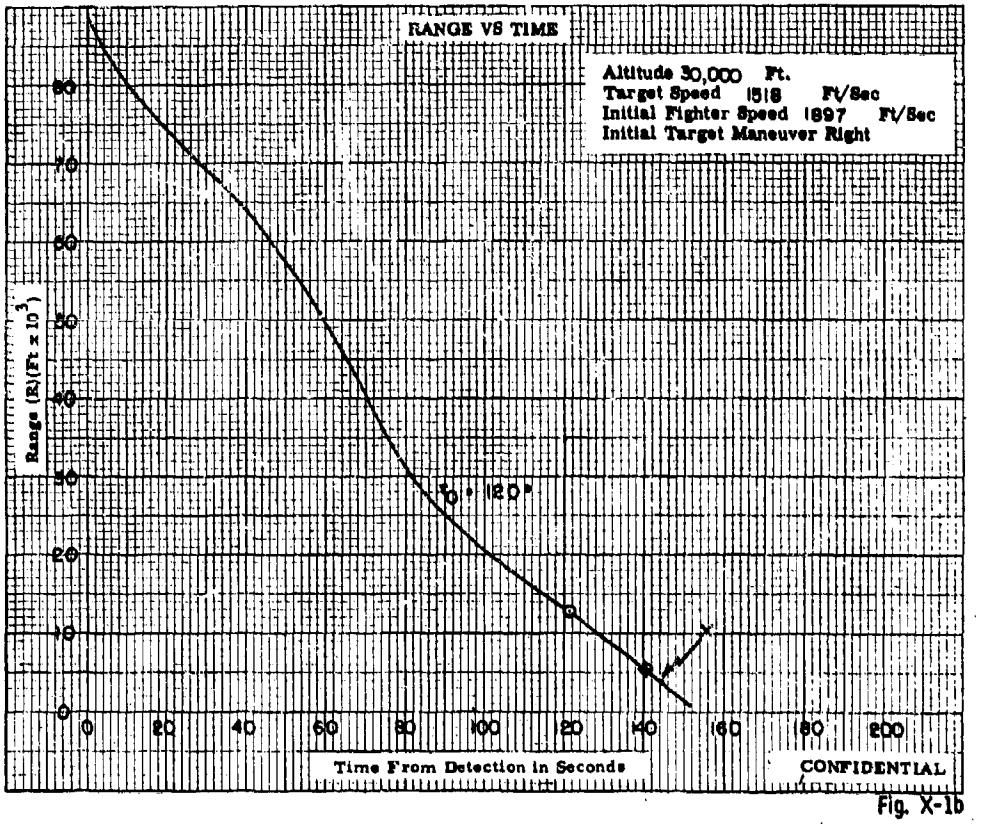

RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Range (R)(Ft x 10³)
80
70
60
50
40
30
20
10
0
ψ_0 = 120°
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds
CONFIDENTIAL

Fig. X-1b

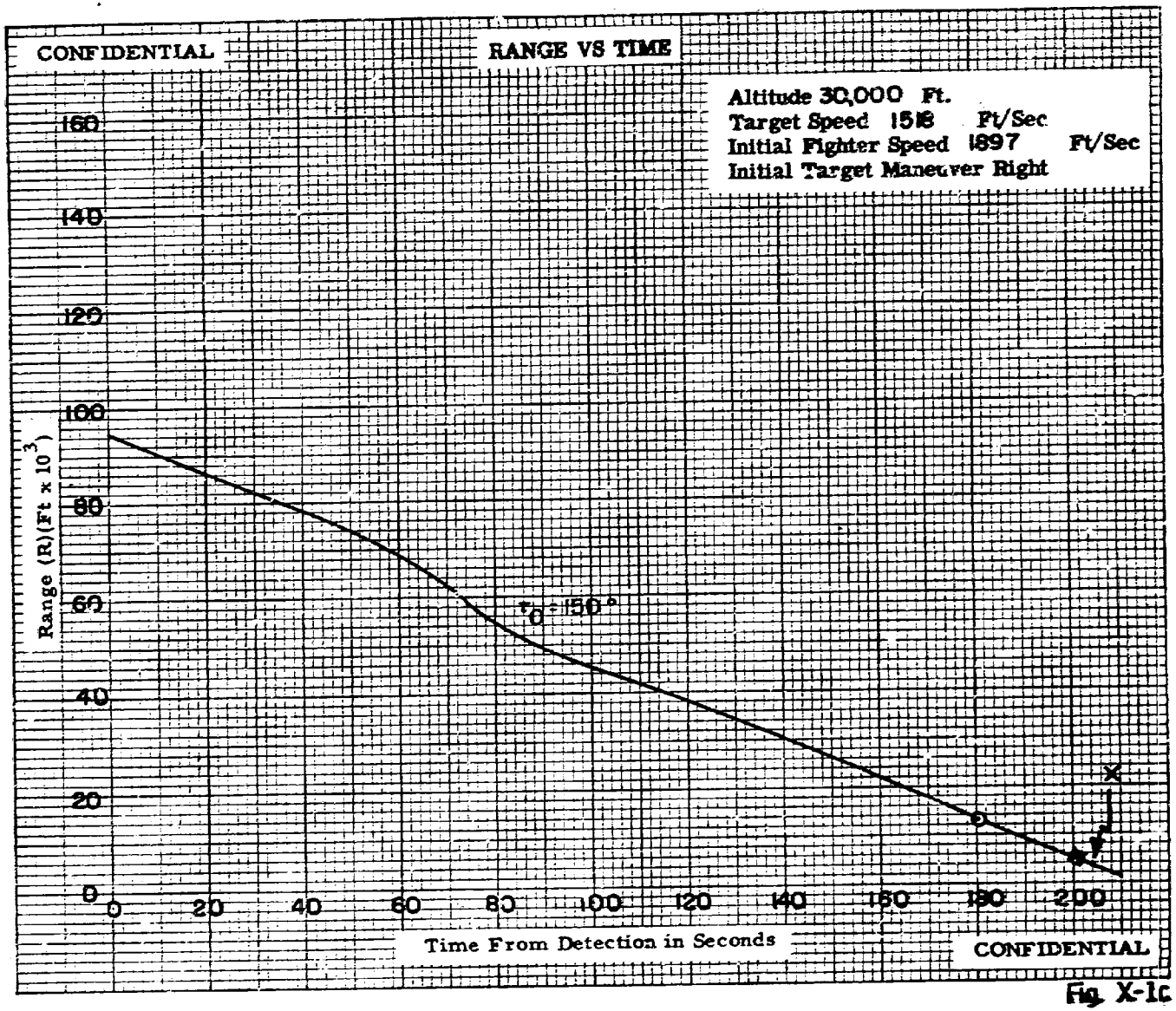
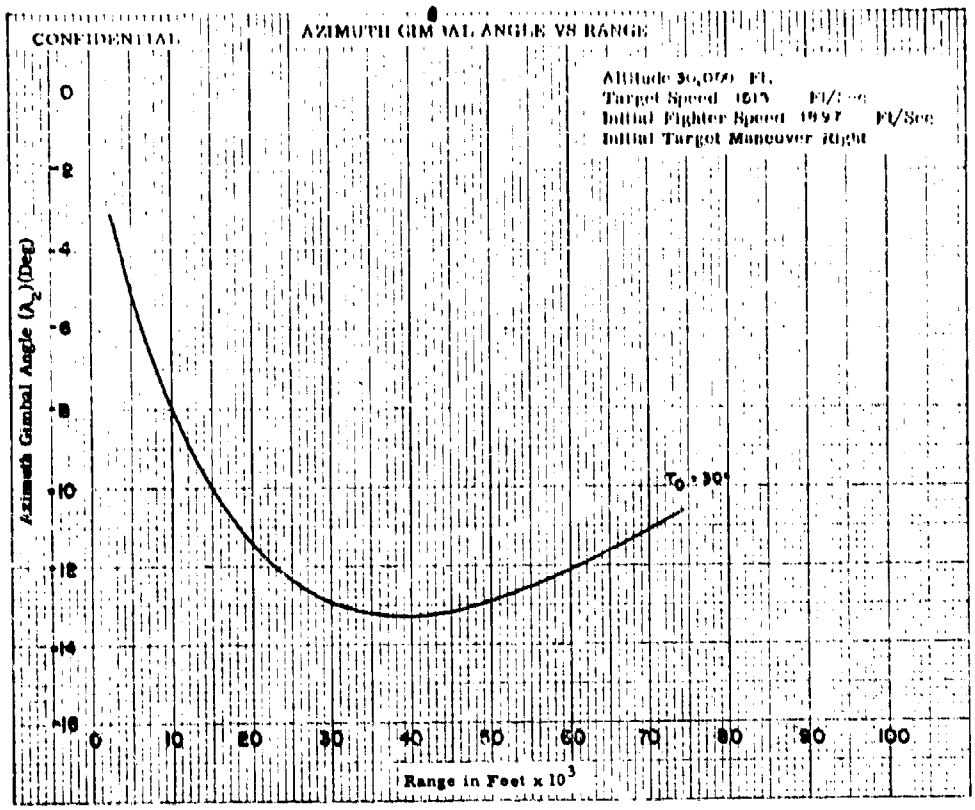

CONFIDENTIAL
RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Range (R)(Ft x 10^3)
160
140
120
100
80
60
40
20
0
$\tau_0 = 150°$
X
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds
CONFIDENTIAL

Fig. X-1c


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1997 Ft/Sec
Initial Target Maneuver Right
Azimuth Gimbal Angle (λ_2)(Deg)
0
-2
-4
-6
-8
-10
-12
-14
-16
T_0 = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

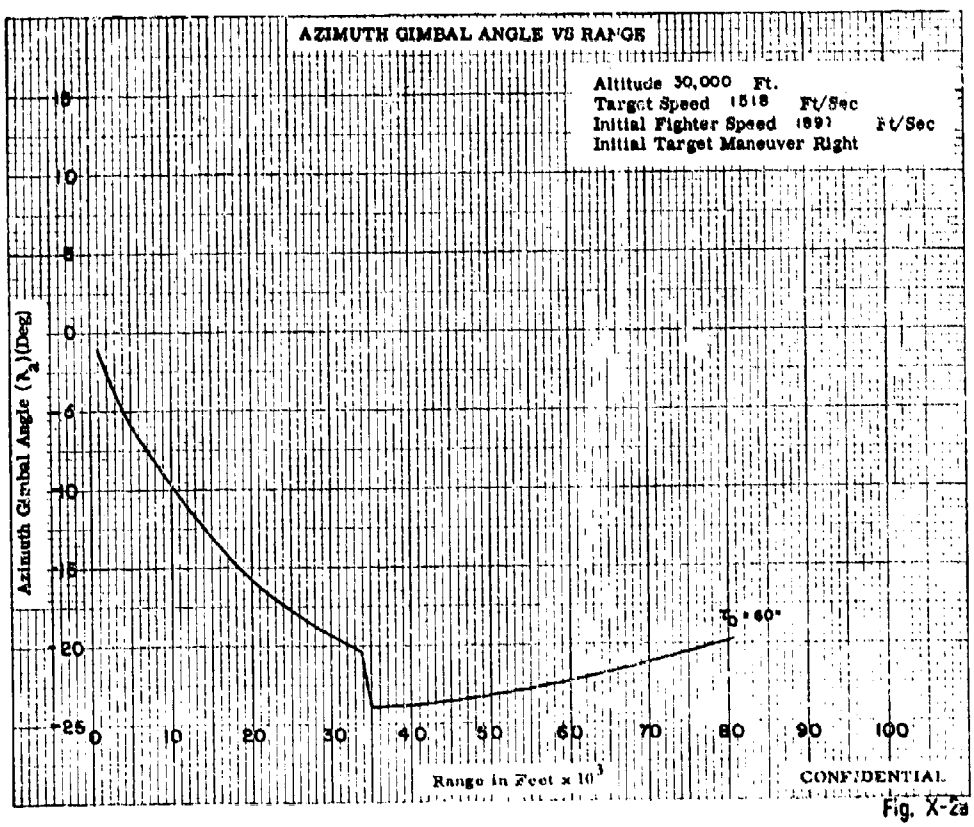

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1997 Ft/Sec
Initial Target Maneuver Right
Azimuth Gimbal Angle (λ_2)(Deg)
10
5
0
-5
-10
-15
-20
-25
T_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-2a

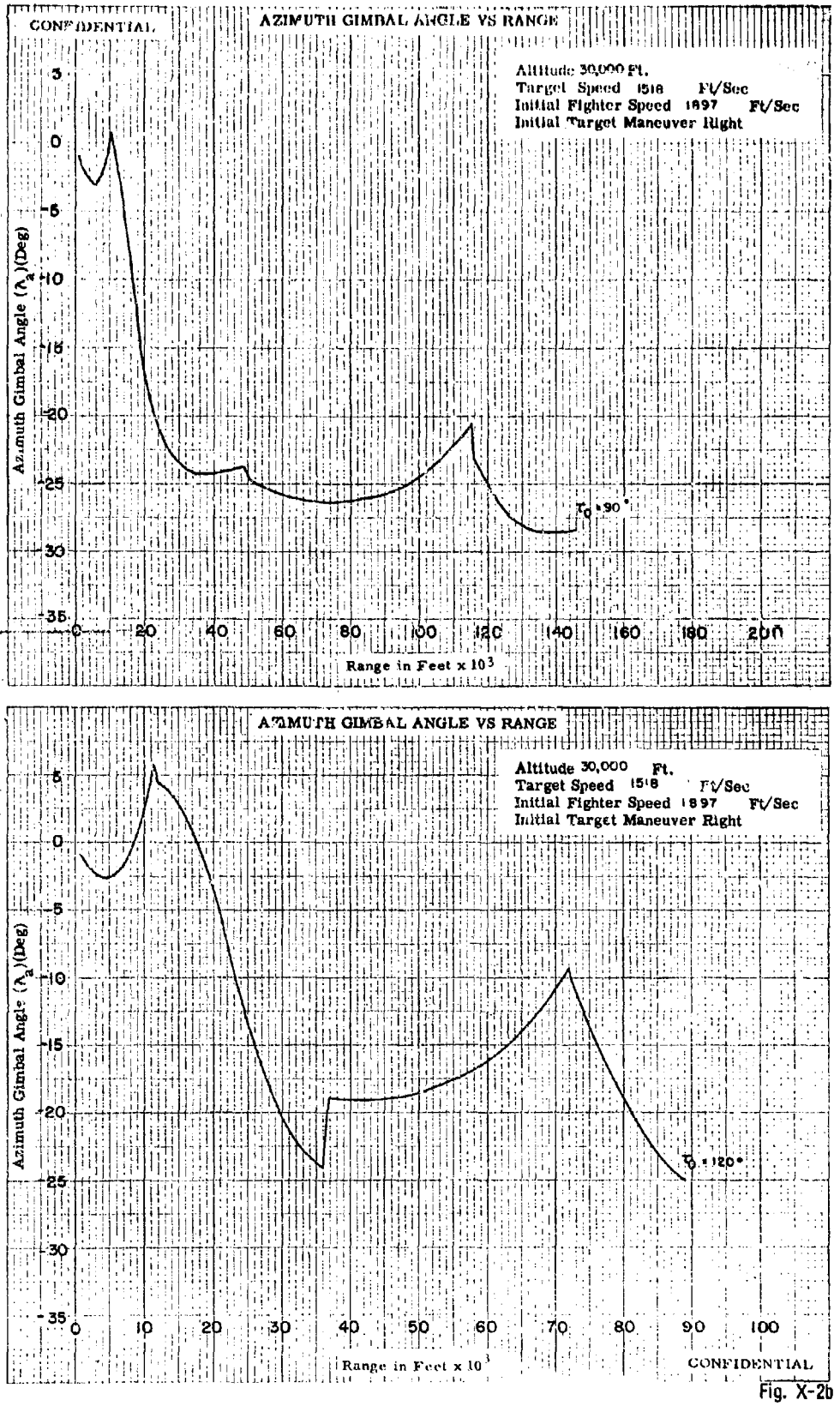

CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Azimuth Gimbal Angle (Λ_a)(Deg)
3
0
-5
-10
-15
-20
-25
-30
-35
Γ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Azimuth Gimbal Angle (Λ_a)(Deg)
5
0
-5
-10
-15
-20
-25
-30
-35
Γ_0 = 120°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-2b

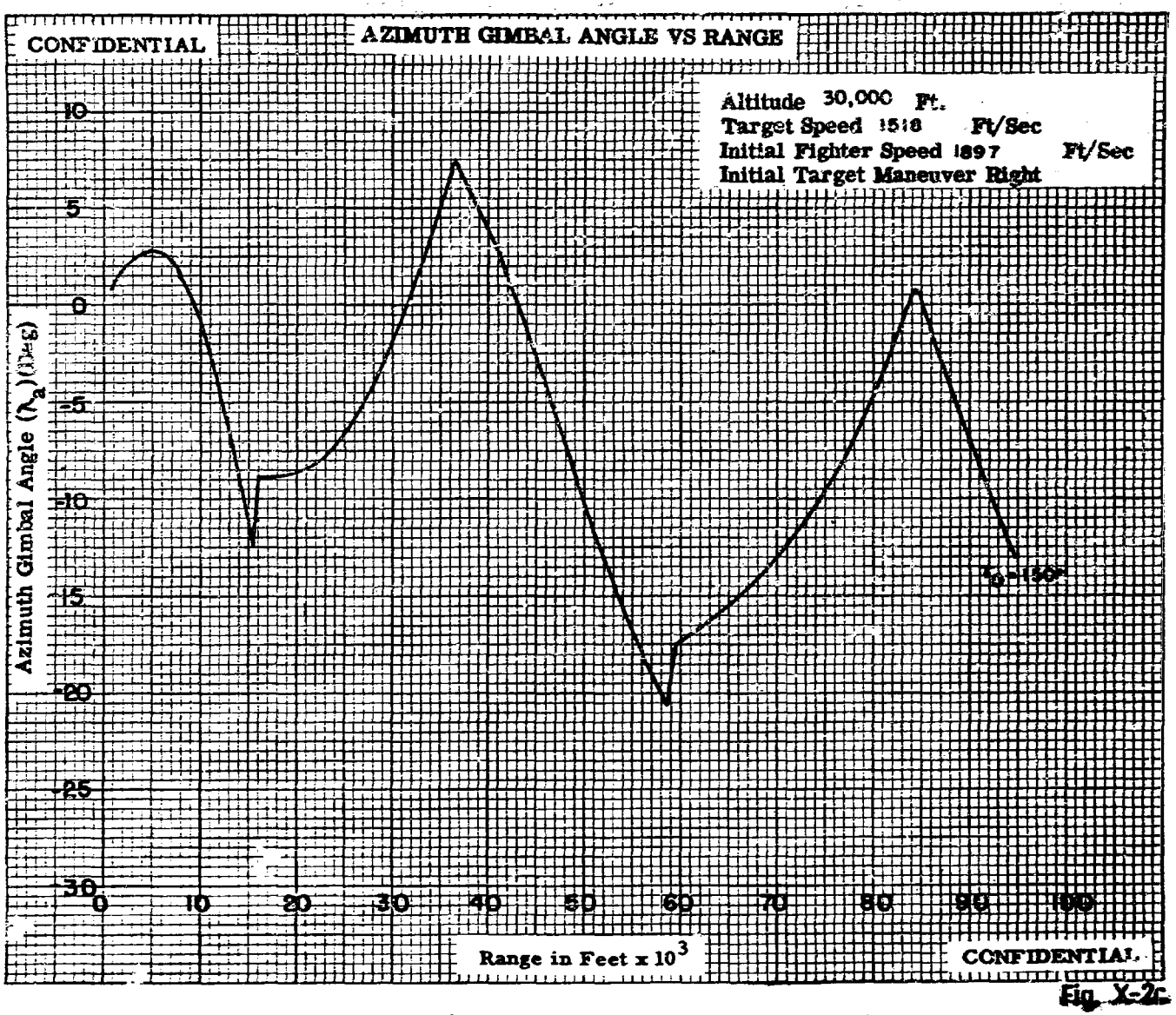
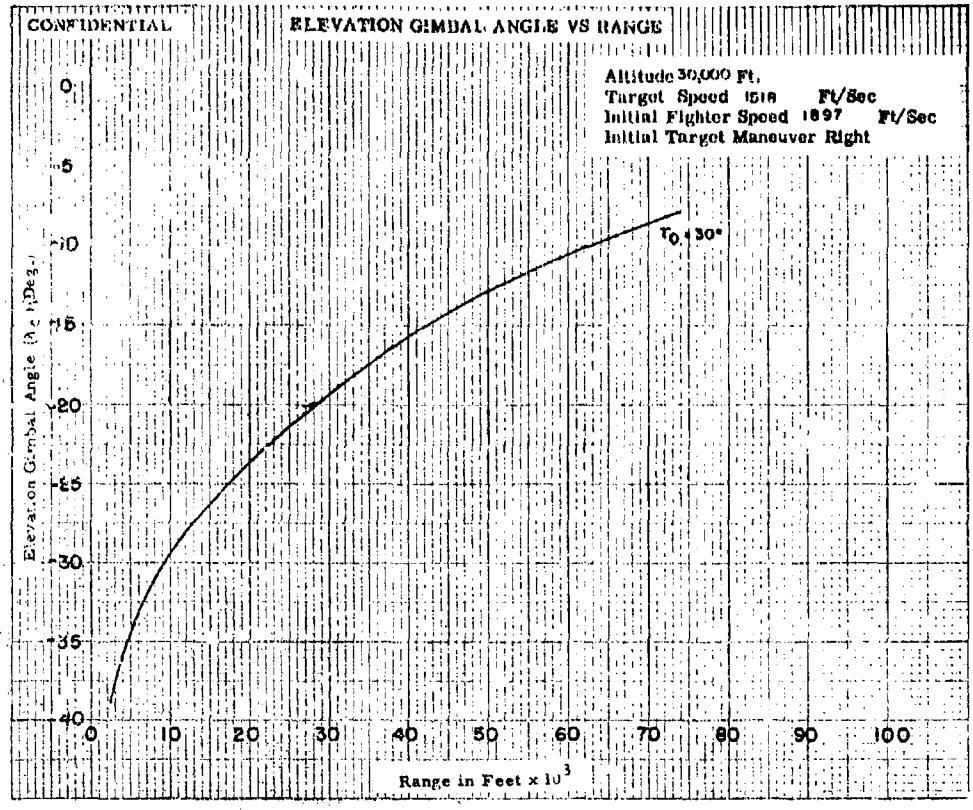
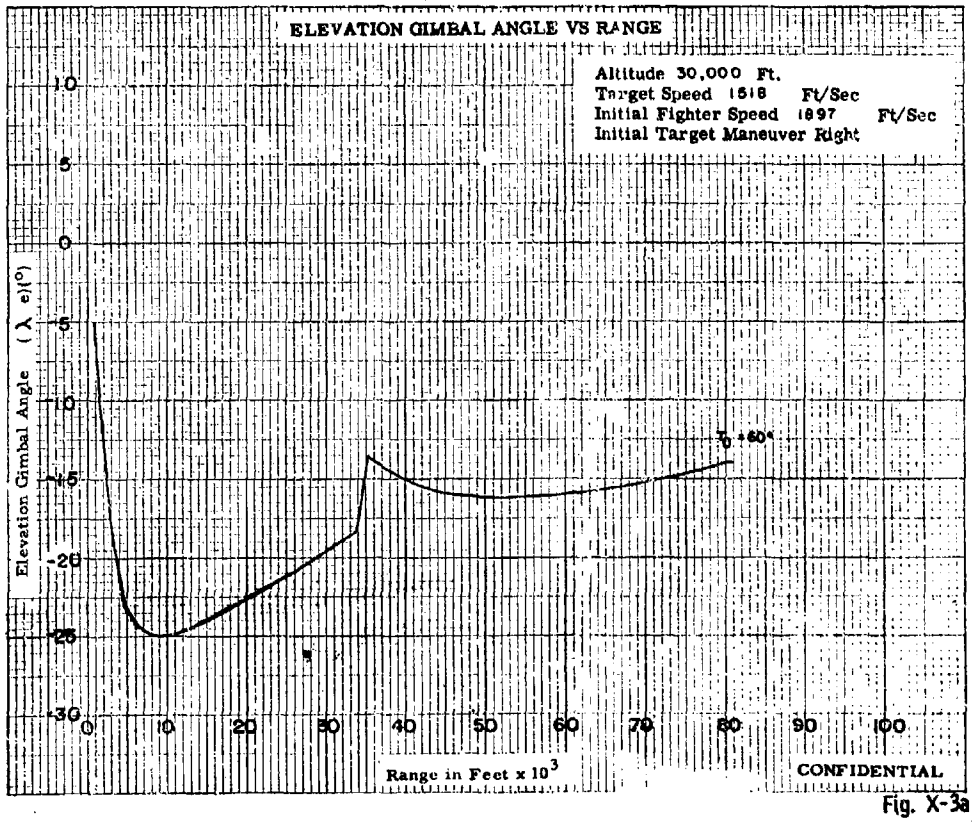

CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Azimuth Gimbal Angle (λ_a) (Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
λ_0 = 150°
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-2c

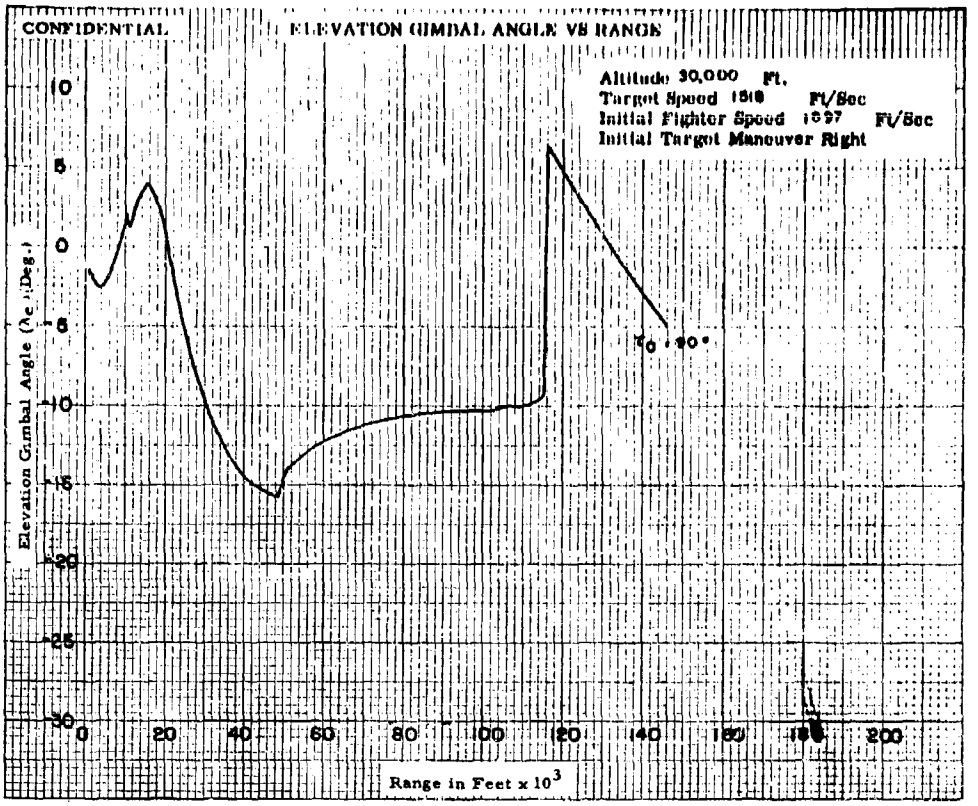
CONFIDENTIAL





CONFIDENTIAL

Fig. X-3a


CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Target Maneuver Right
τ_0 = 90°
Elevation Gimbal Angle (λe) (Deg.)
10
5
0
-5
-10
-15
-20
-25
-30
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

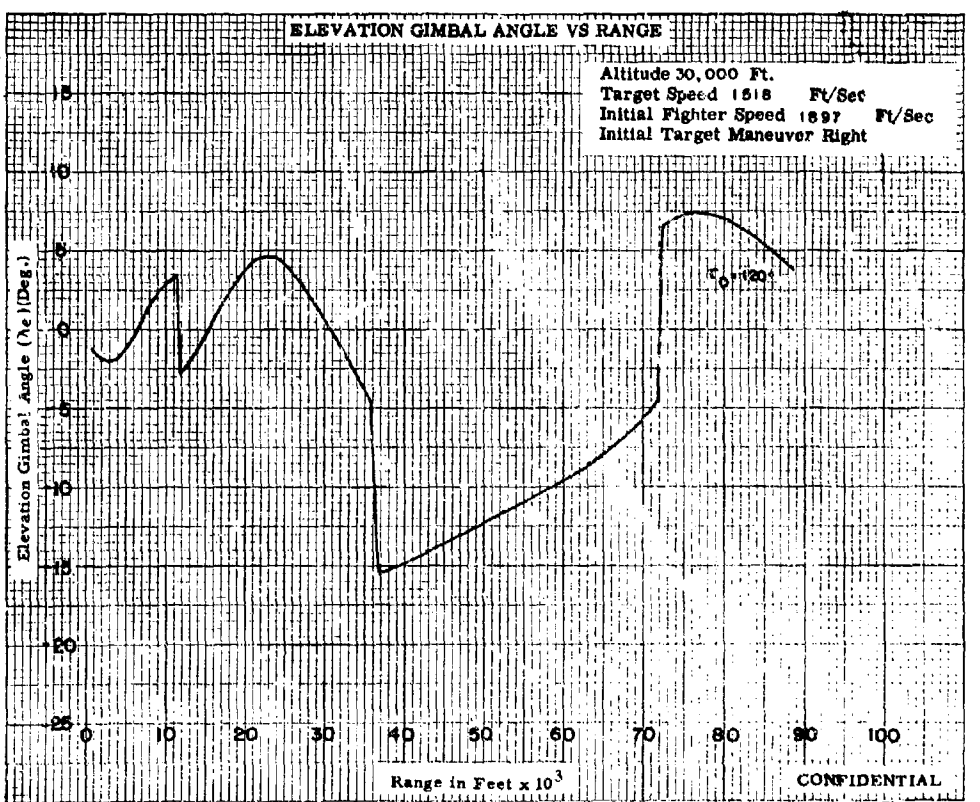

ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Target Maneuver Right
τ_0 = 120°
Elevation Gimbal Angle (λe) (Deg.)
15
10
5
0
-5
-10
-15
-20
-25
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-3b

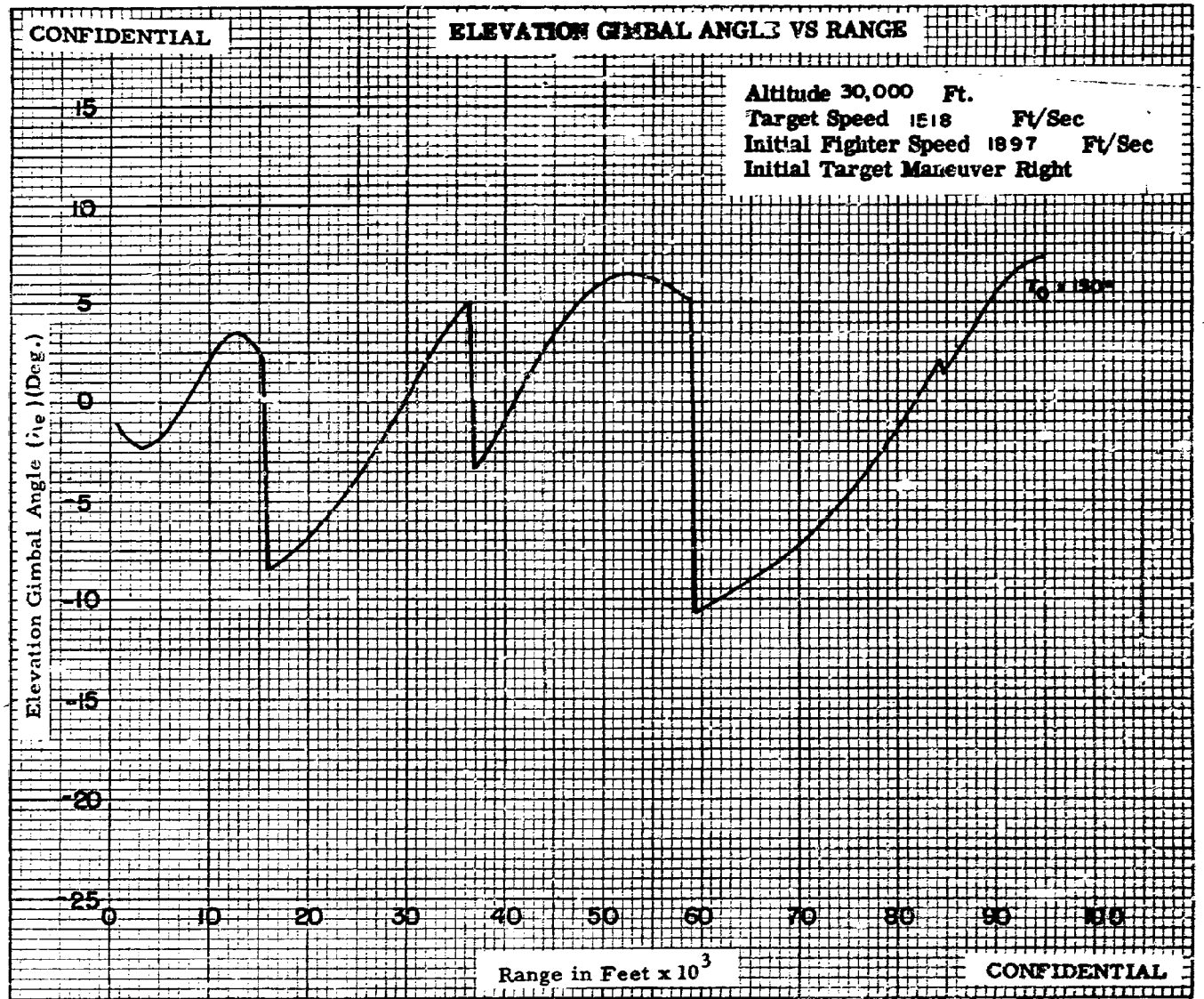
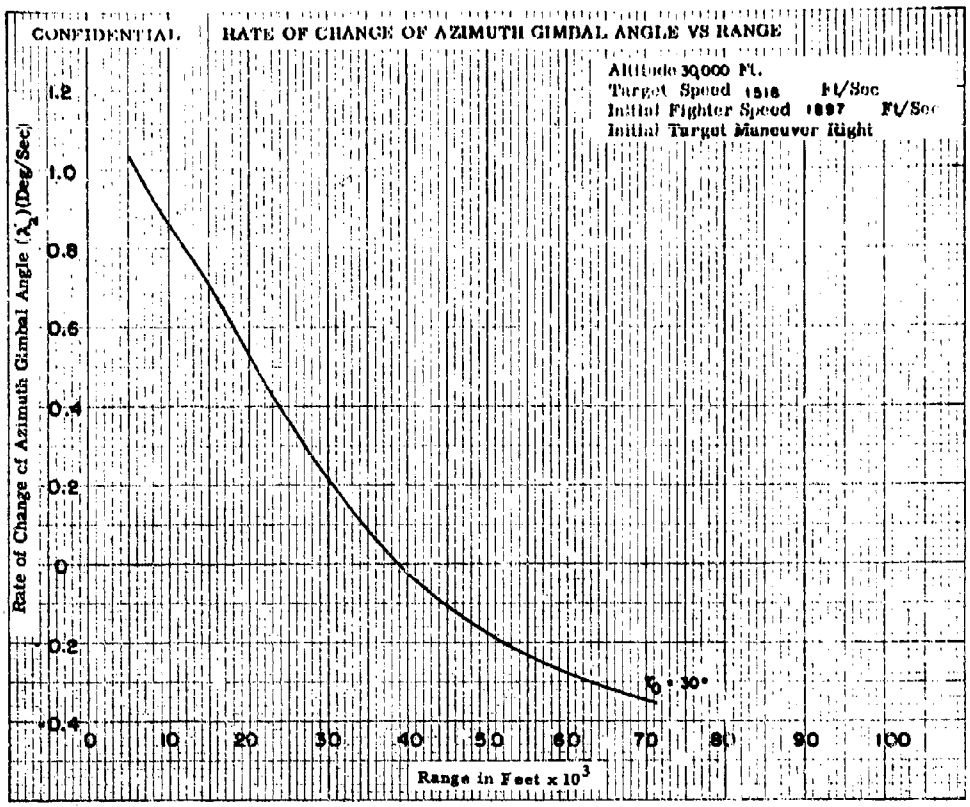

CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
T_0 = 130°
Elevation Gimbal Angle (i_{le}) (Deg.)
15
10
5
0
-5
-10
-15
-20
-25
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-3c


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_a$)(Deg/Sec)
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
T_0 = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

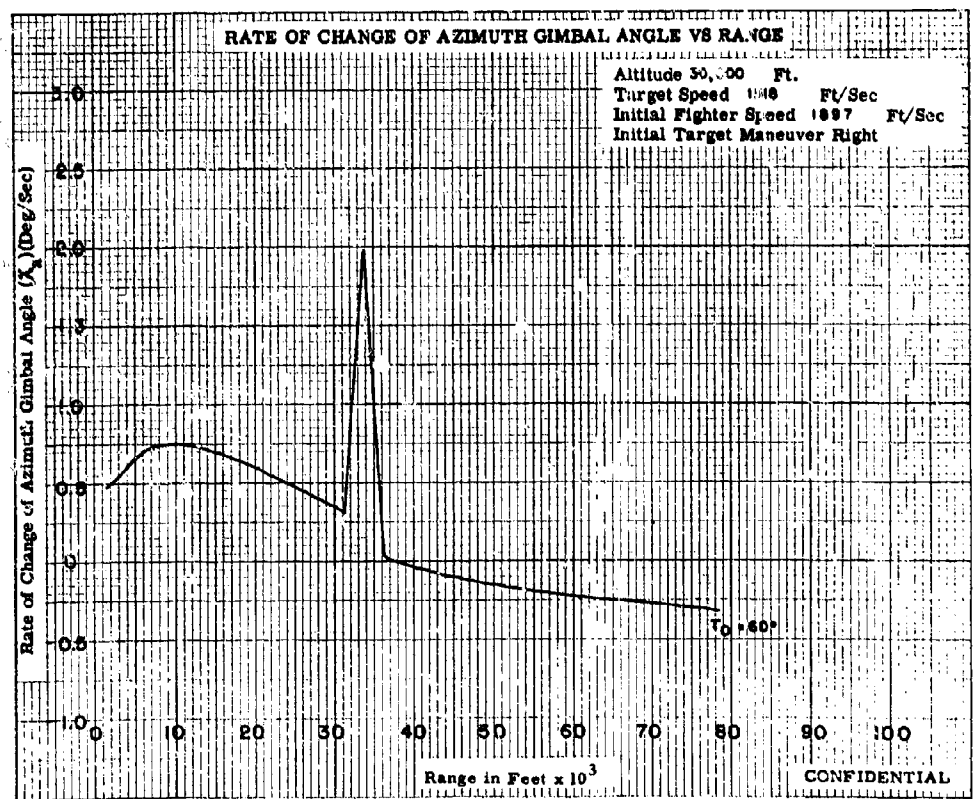
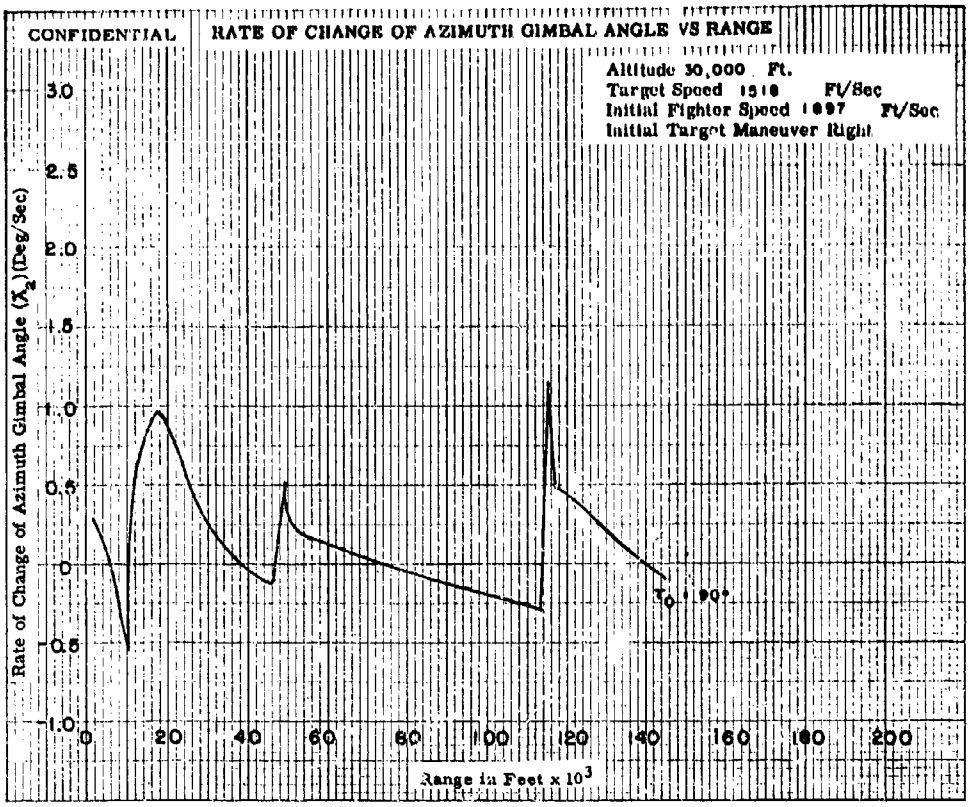

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_a$)(Deg/Sec)
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
-1.0
T_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-4a


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
-1.0
τ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

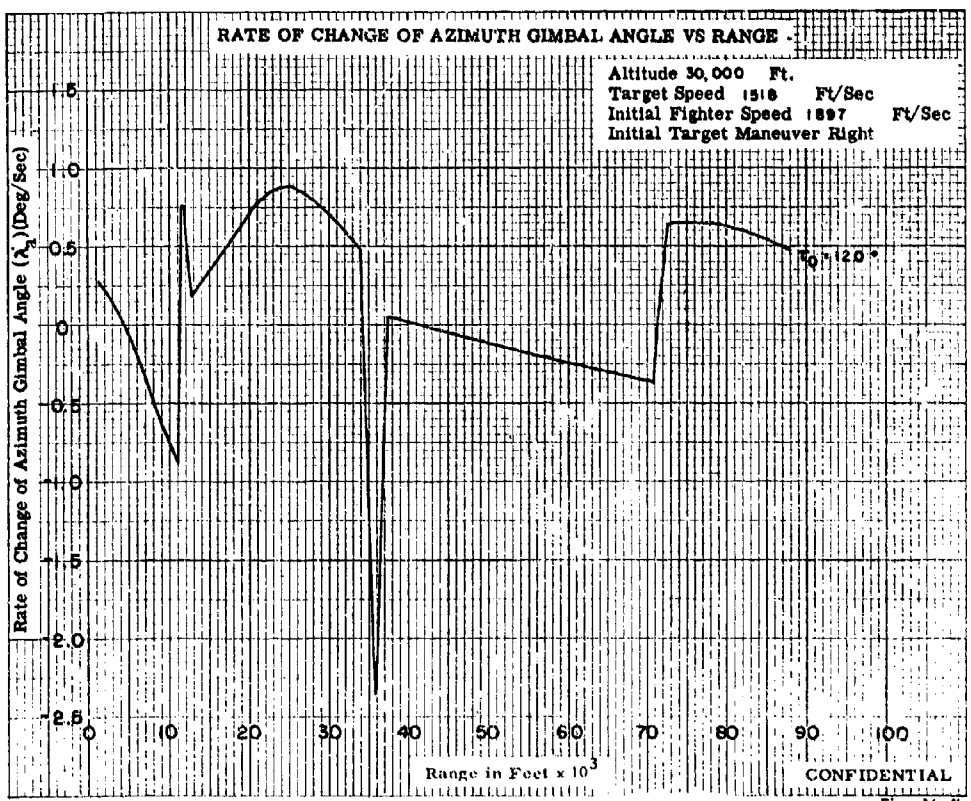

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
-2.5
τ_0 = 120°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-40

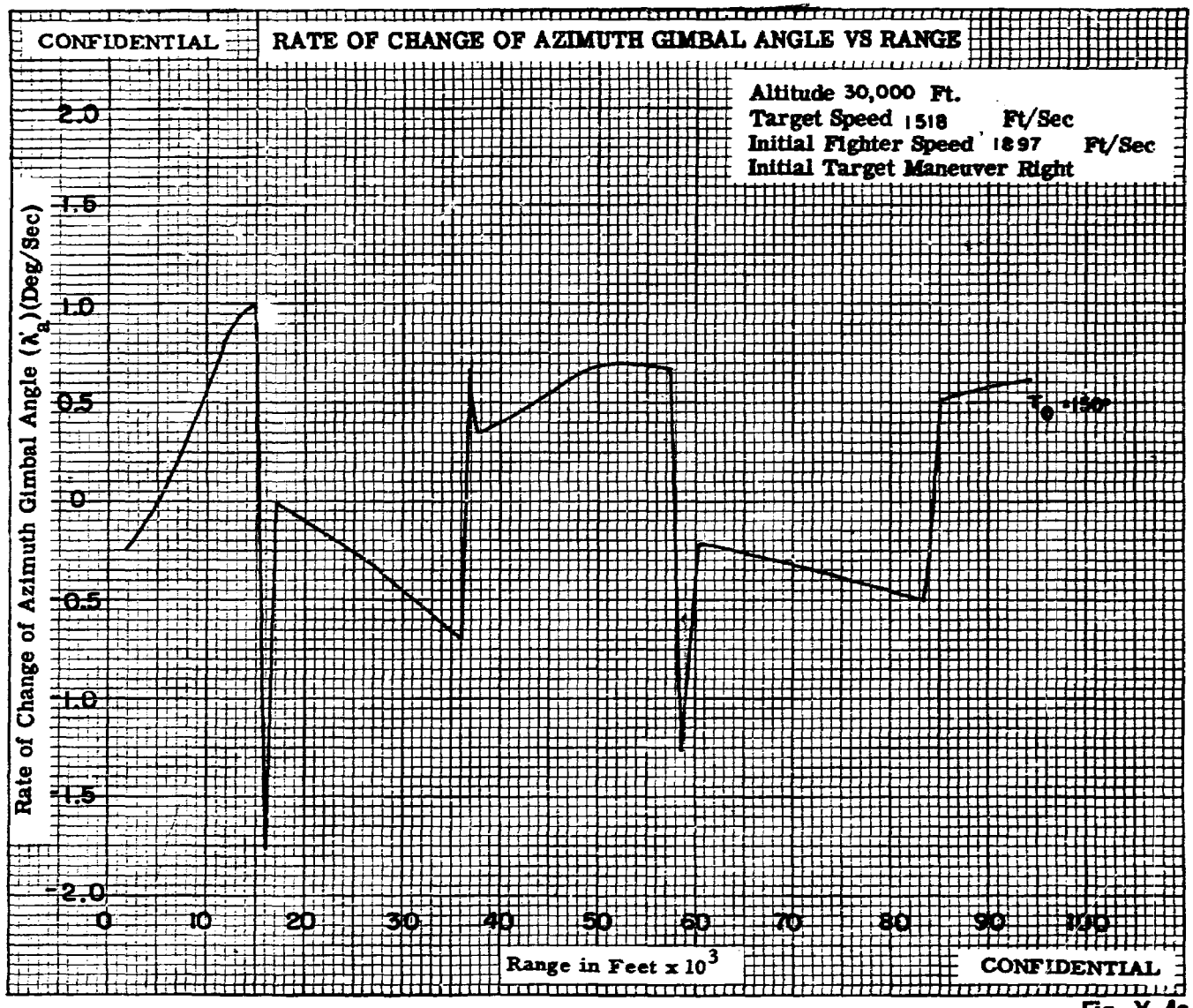
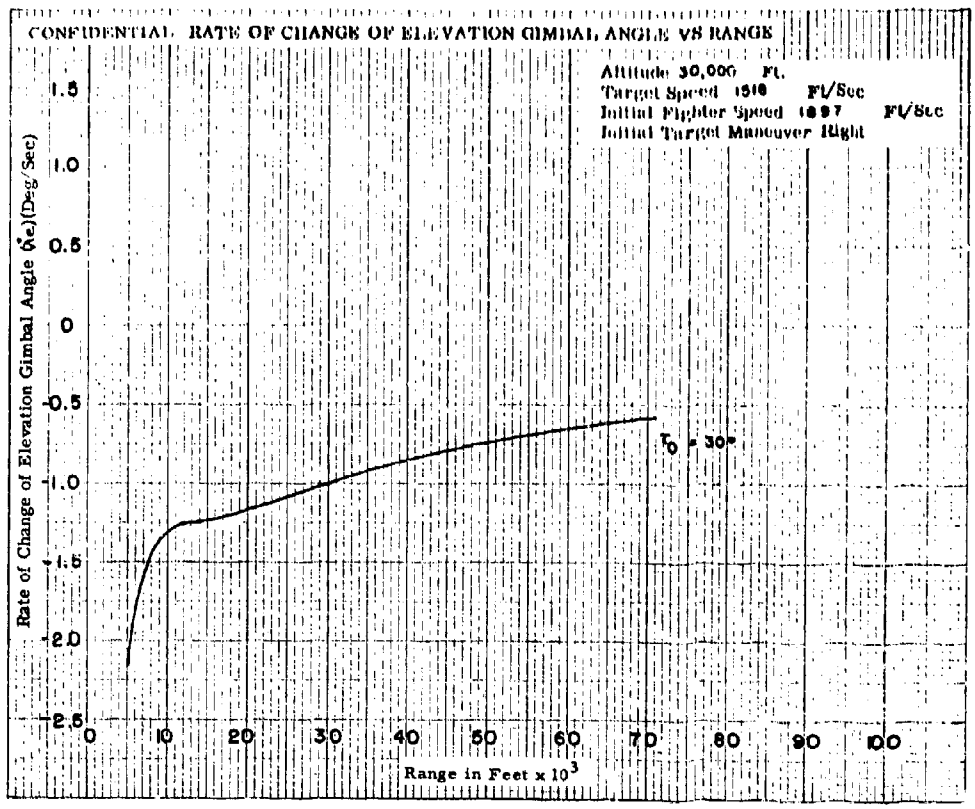

CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_a$) (Deg/Sec)
2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
τ_0 = 130°
CONFIDENTIAL

Fig. X-4c


CONFIDENTIAL RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Rate of Change of Elevation Gimbal Angle $\dot{\lambda}_e$ (Deg/Sec)
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
-2.5
$\lambda_0 = 30°$
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

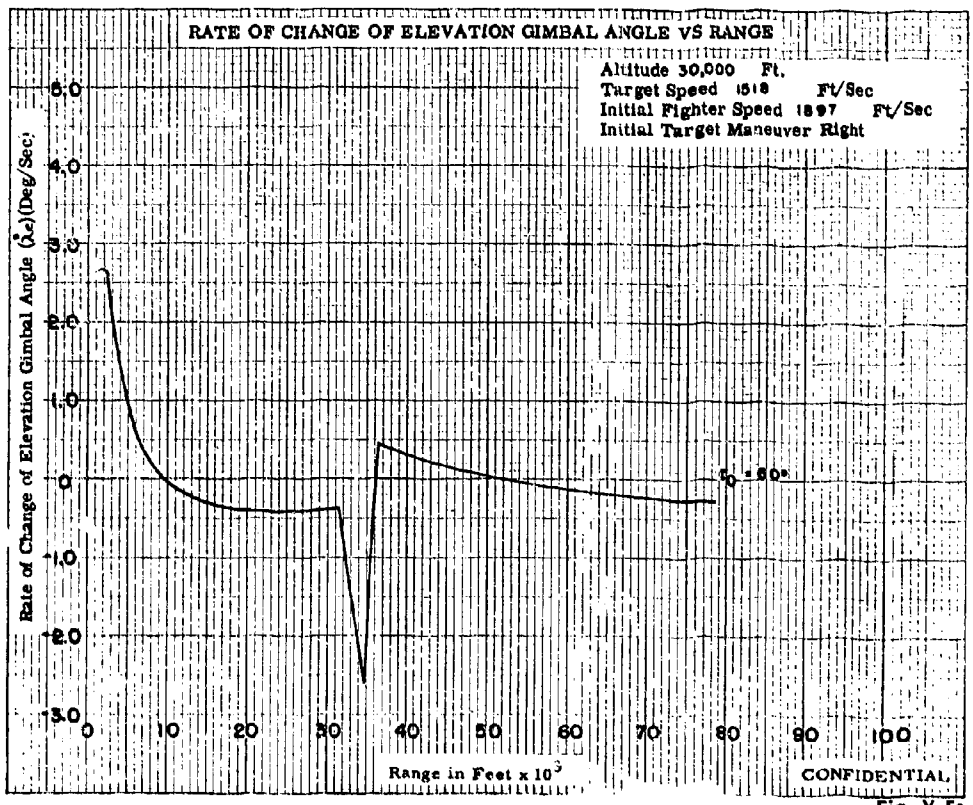
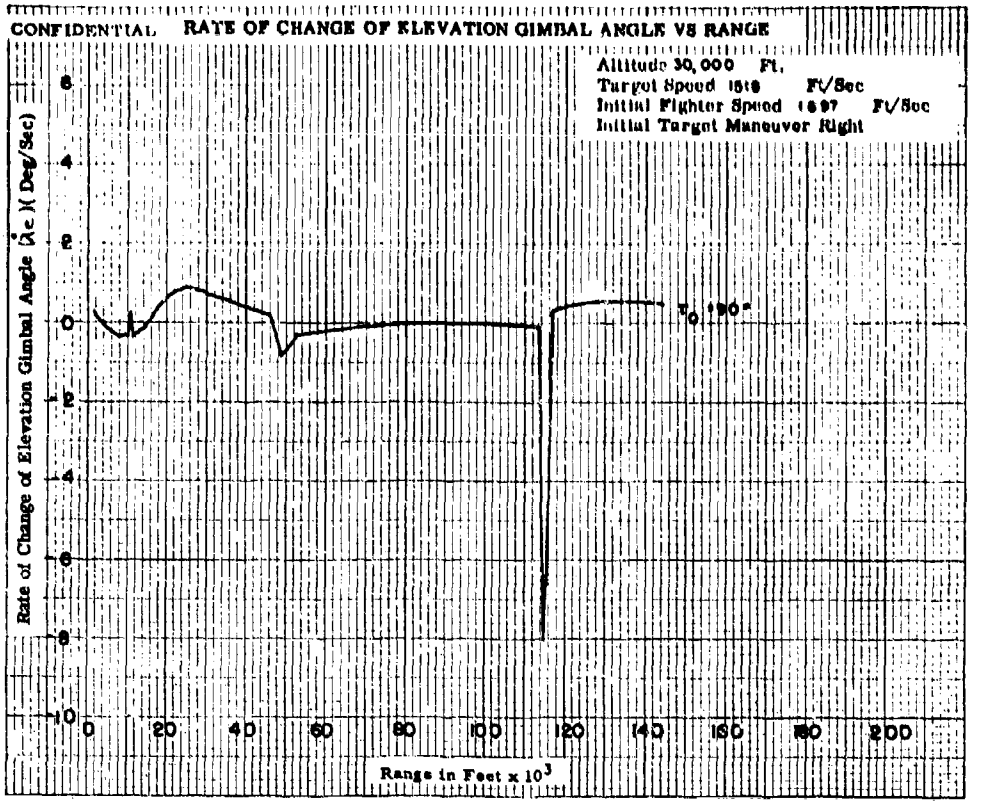
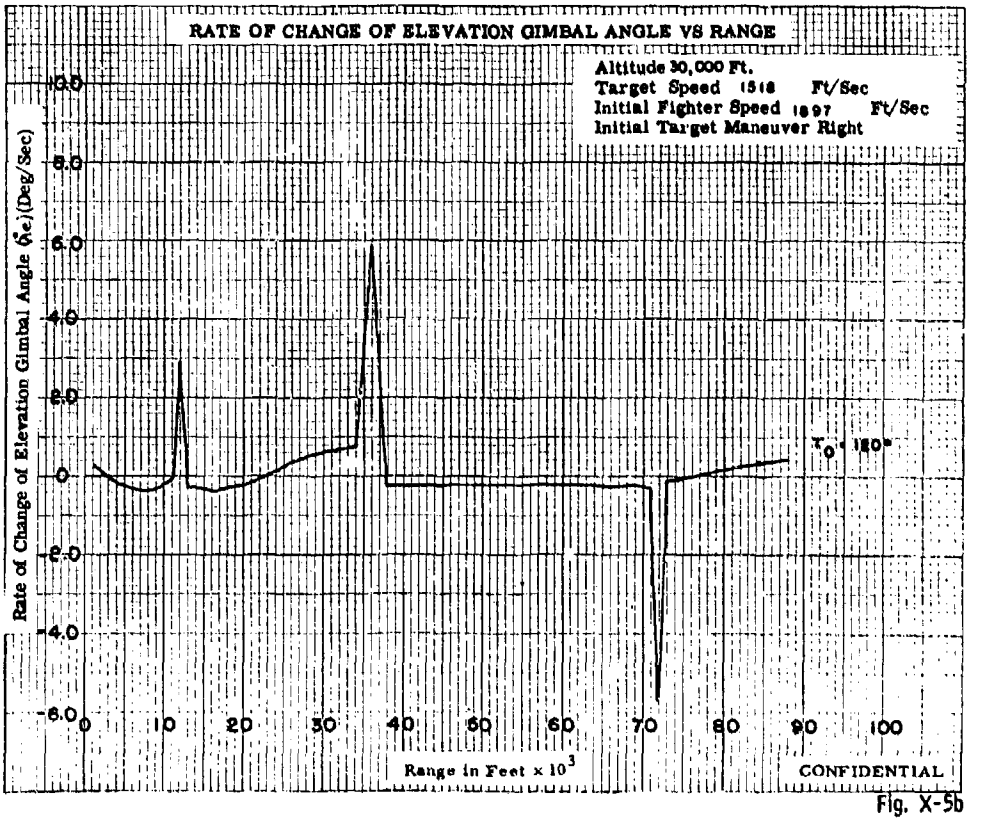

RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Rate of Change of Elevation Gimbal Angle $\dot{\lambda}_e$ (Deg/Sec)
5.0
4.0
3.0
2.0
1.0
0
-1.0
-2.0
-3.0
$\lambda_0 = 60°$
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-5a

CONFIDENTIAL





CONFIDENTIAL

Fig. X-5b

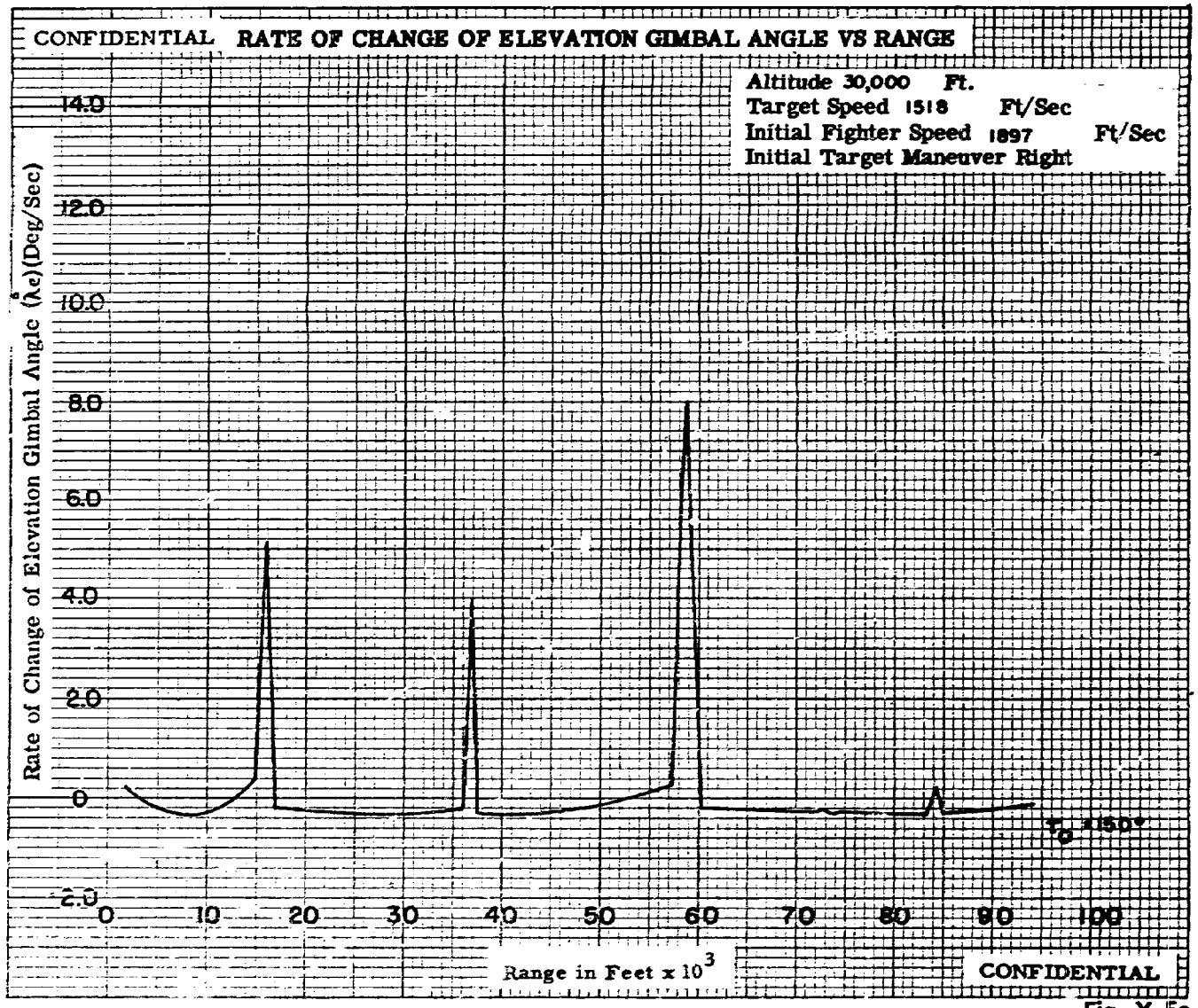
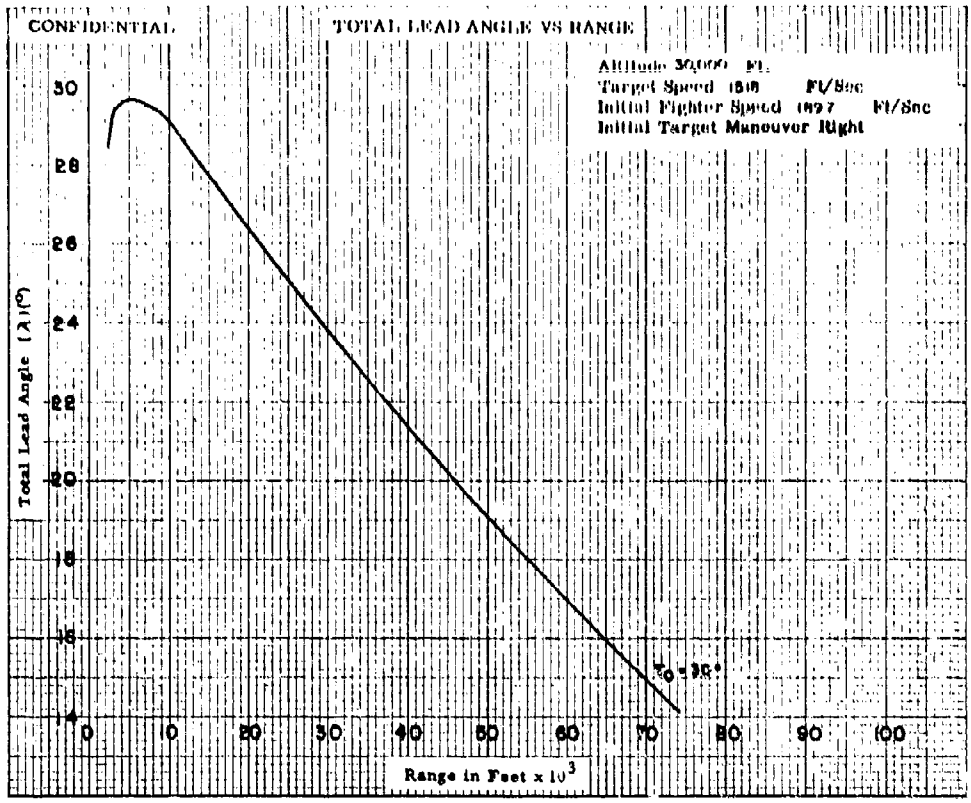

CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Rate of Change of Elevation Gimbal Angle (λe)(Deg/Sec)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0
-2.0
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
T_D x150*
CONFIDENTIAL

Fig X-5c


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Total Lead Angle (λ) (°)
30
28
26
24
22
20
18
16
14
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

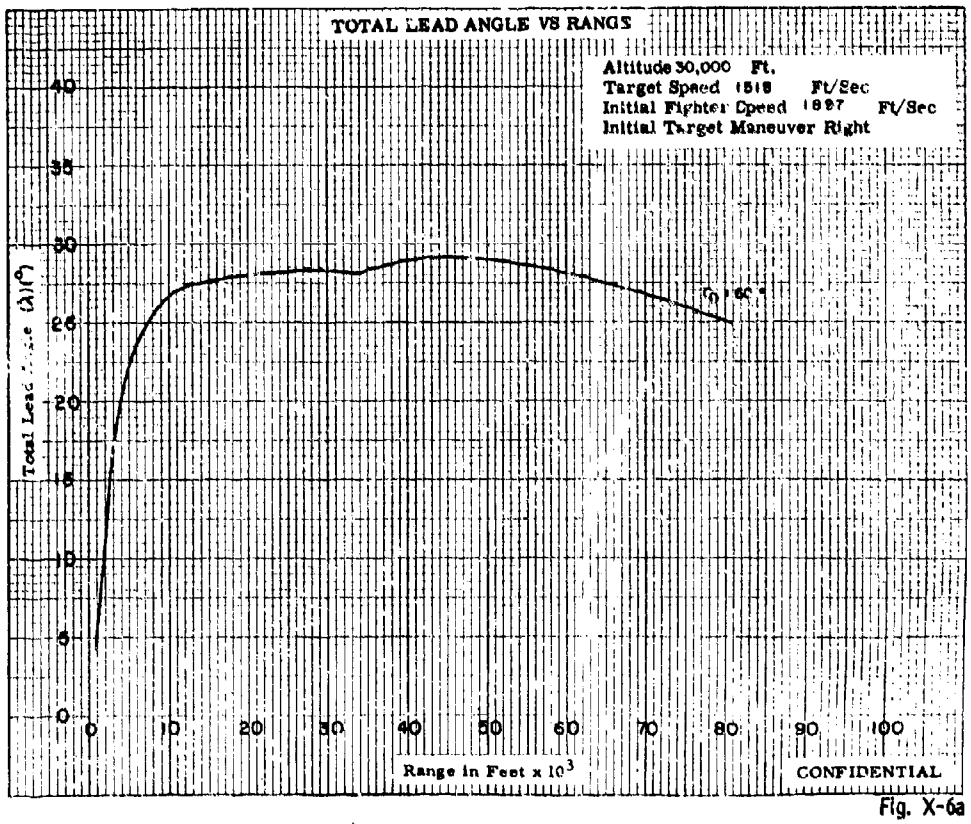
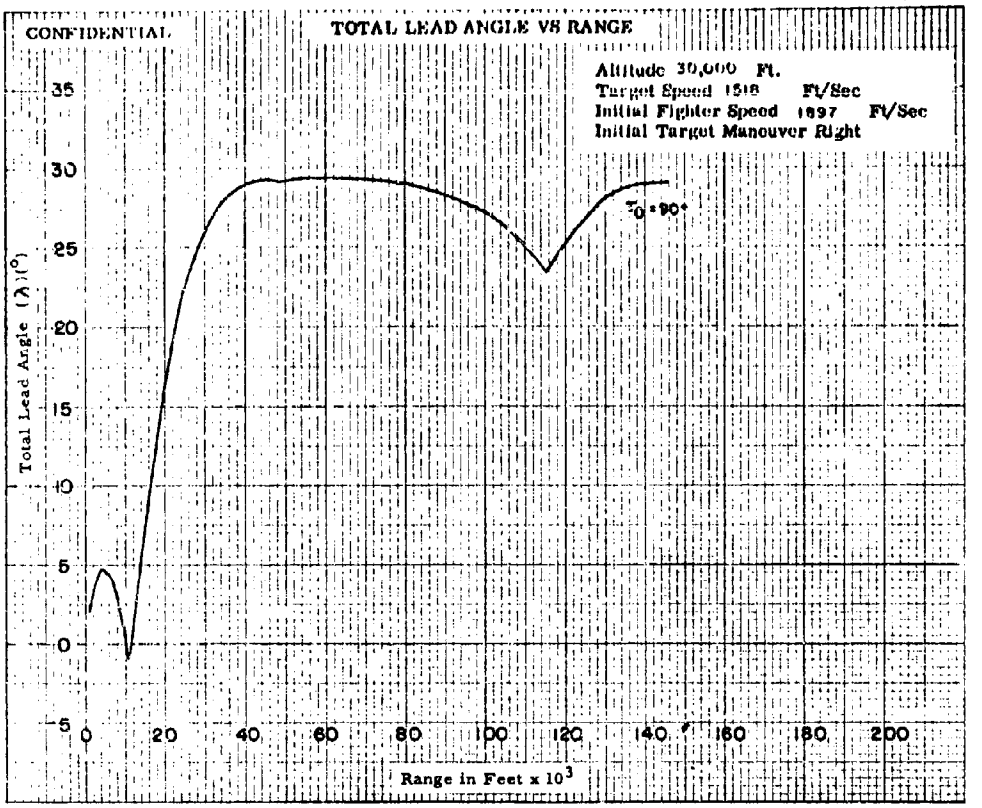

TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
40
35
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-6a


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
τ_0 = 90°
Total Lead Angle (λ)(°)
35
30
25
20
15
10
5
0
-5
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

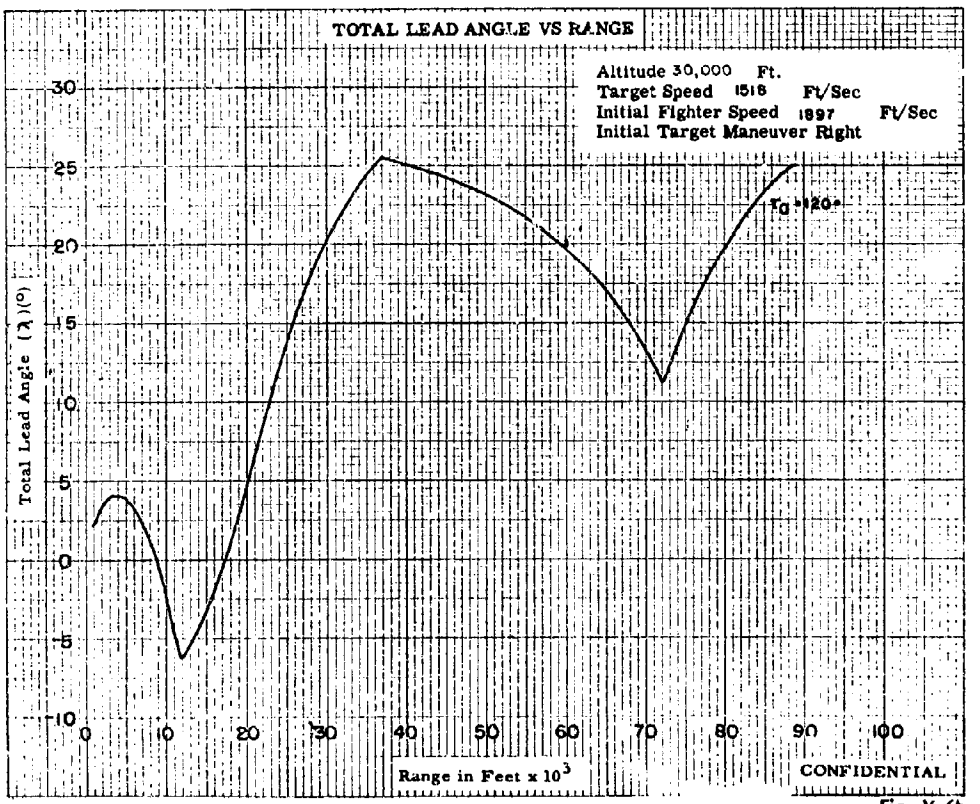

TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
τ_0 = 120°
Total Lead Angle (λ)(°)
30
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-6b

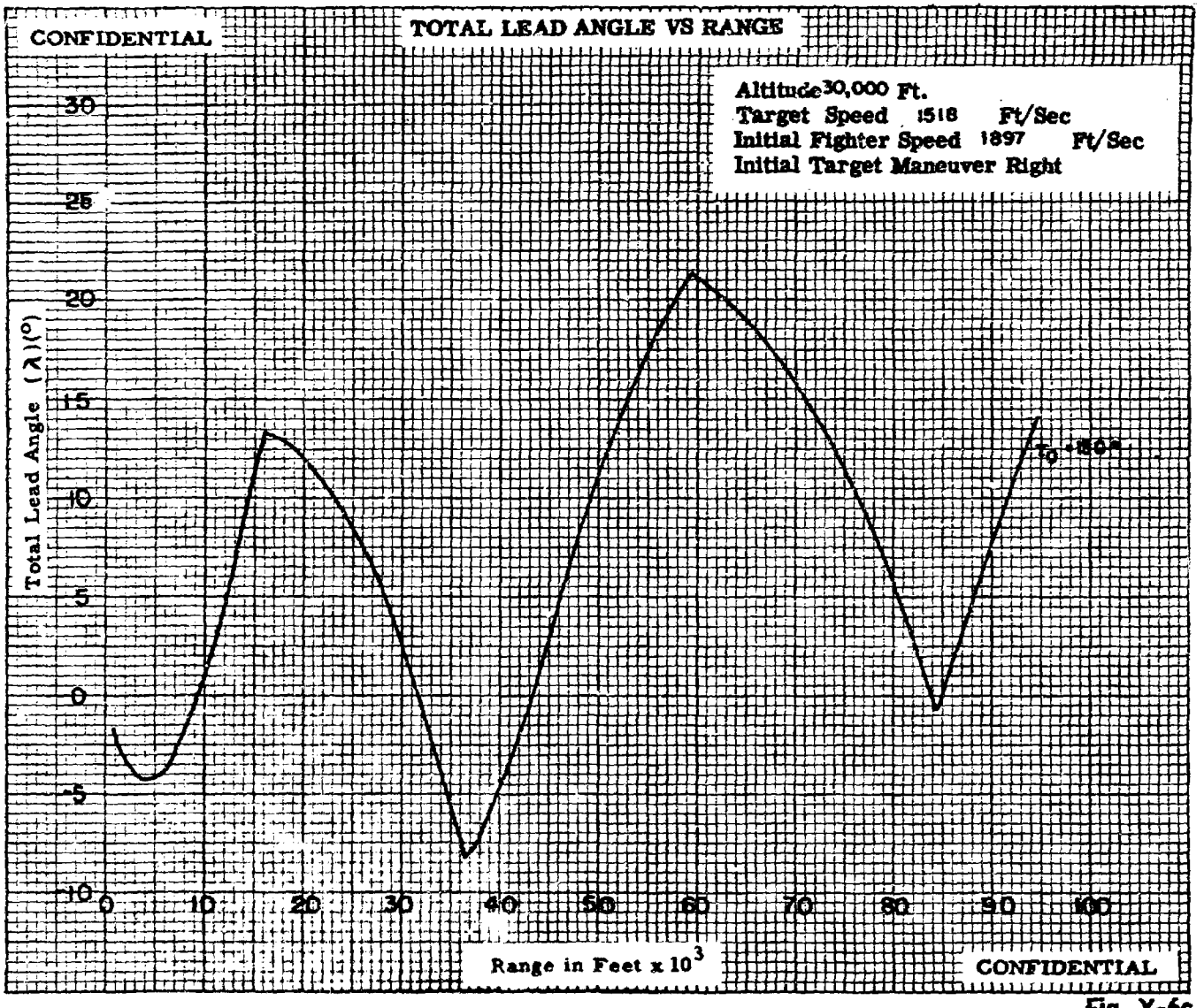
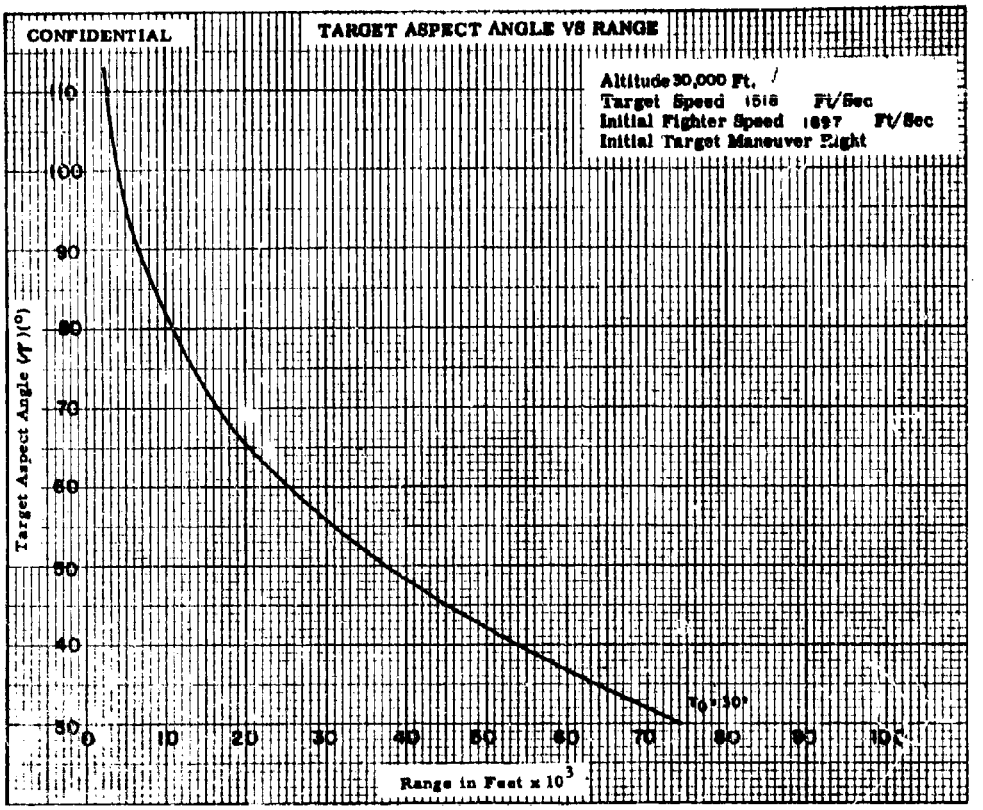

CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Total Lead Angle (λ)(°)
30
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
60
70
80
90
100
T_0 +180°
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-6c


CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Target Aspect Angle (ψ)(°)
110
100
90
80
70
60
50
40
T_0 = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

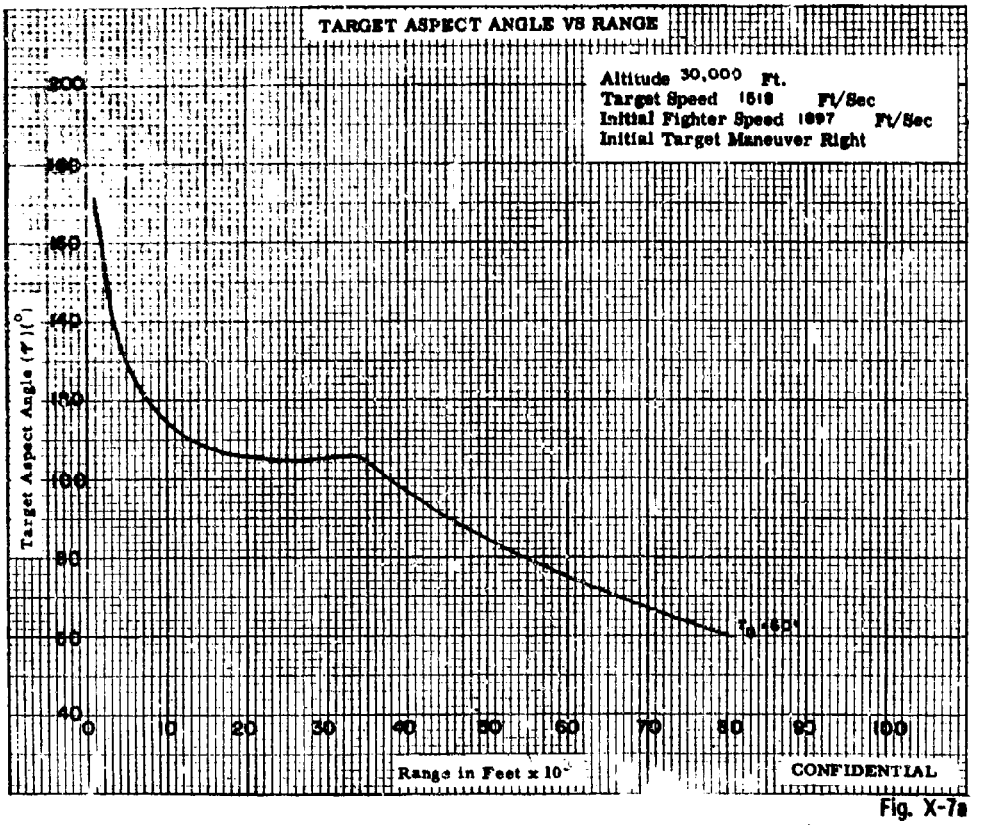
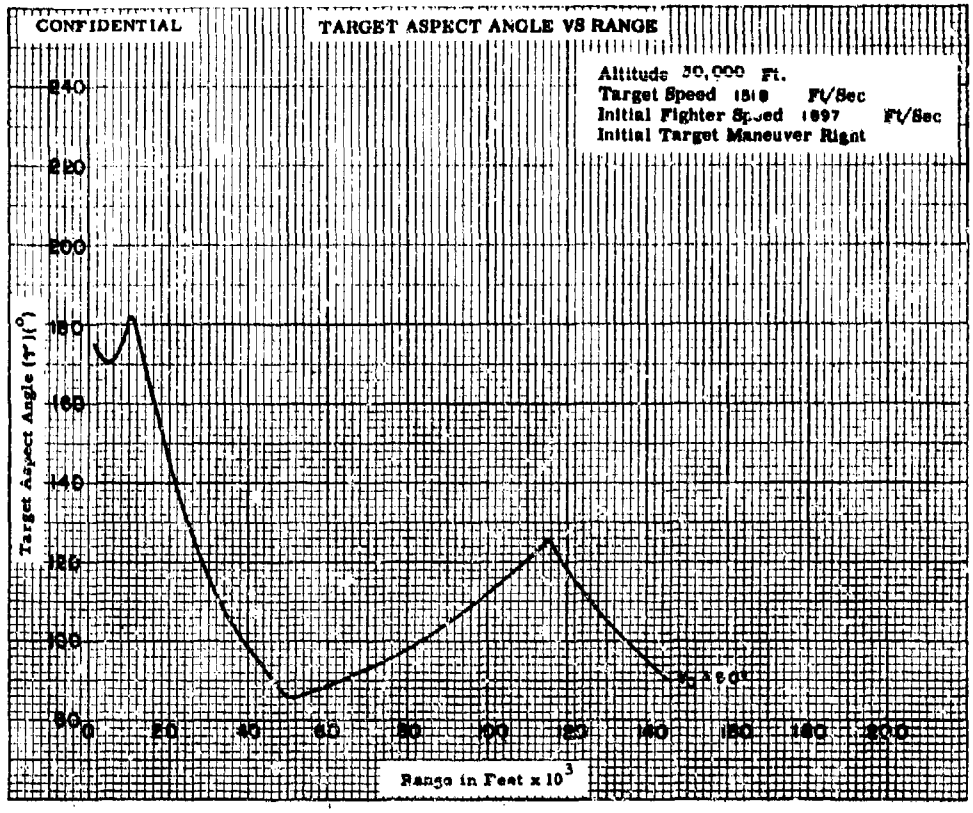

TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Target Aspect Angle (ψ)(°)
200
180
160
140
120
100
80
60
40
T_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-7a


CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Target Aspect Angle (ψ)(°)
240
220
200
180
160
140
120
100
90
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

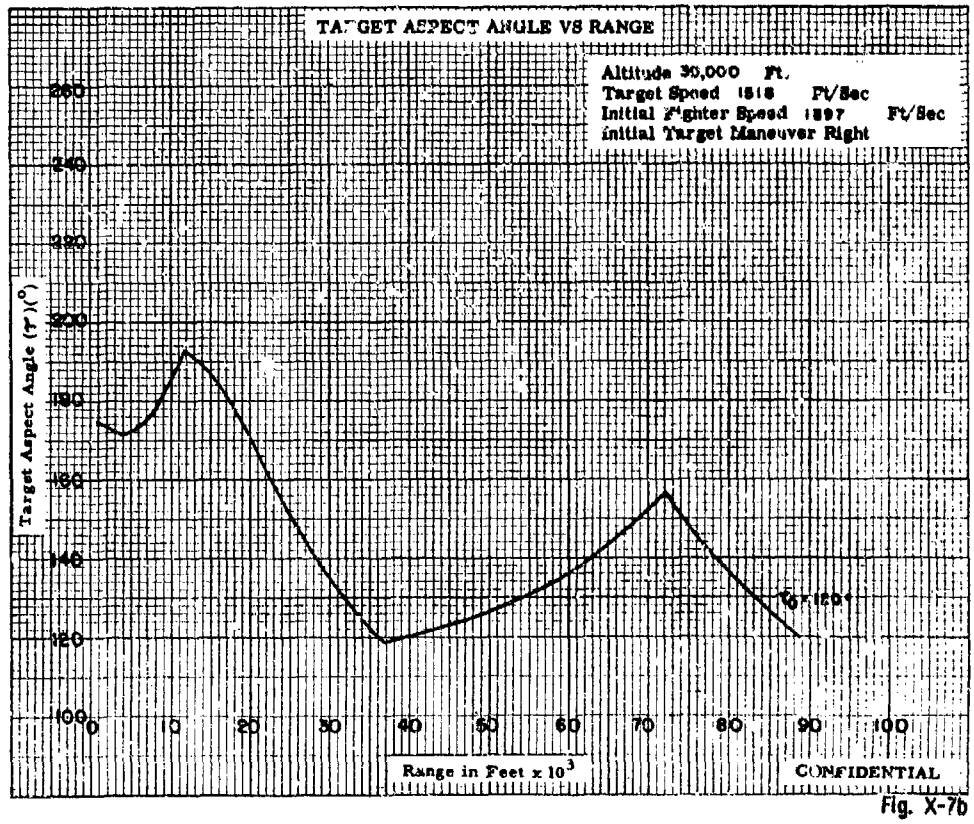

TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Target Aspect Angle (ψ)(°)
260
240
220
200
180
160
140
120
100
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-7b

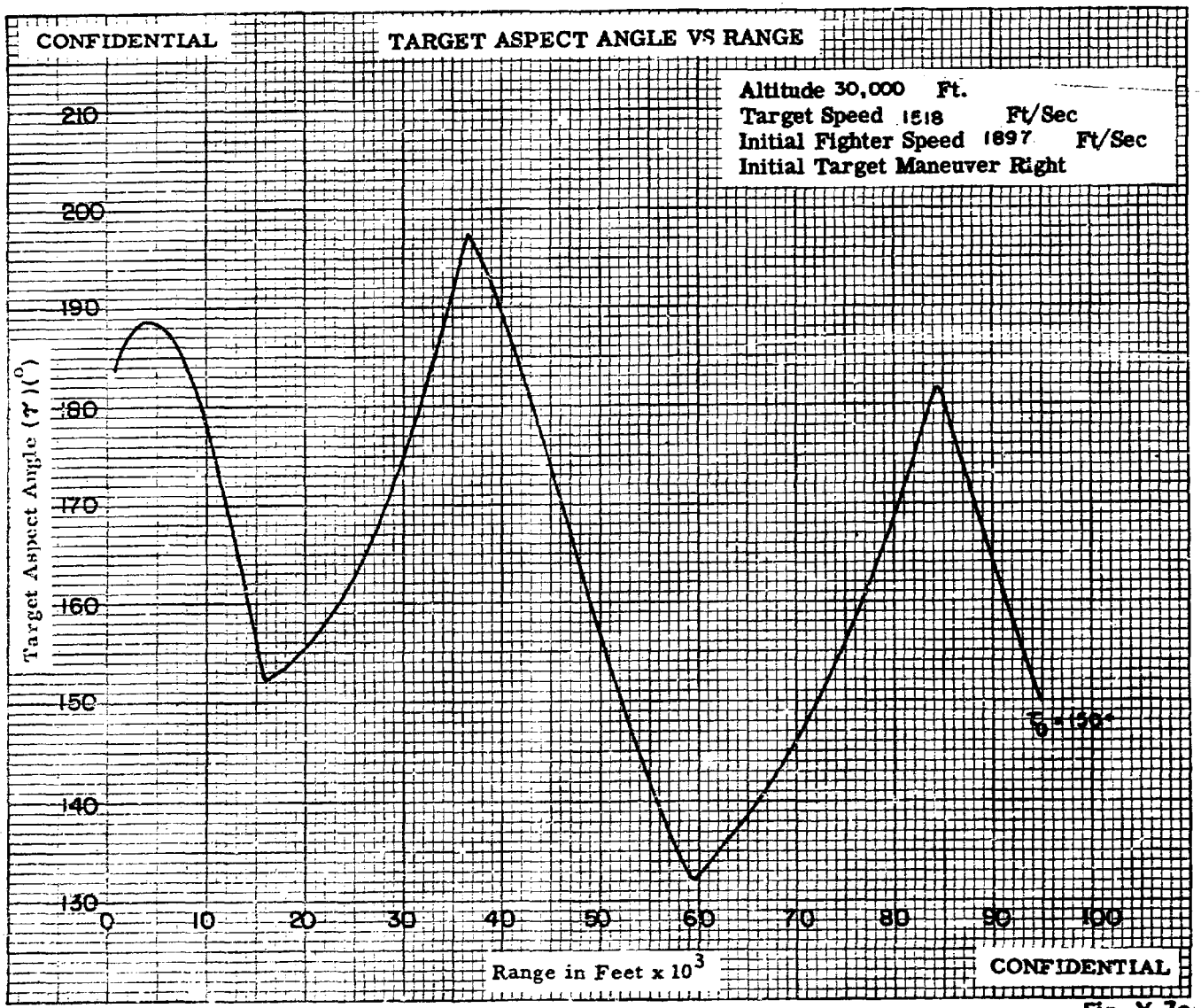
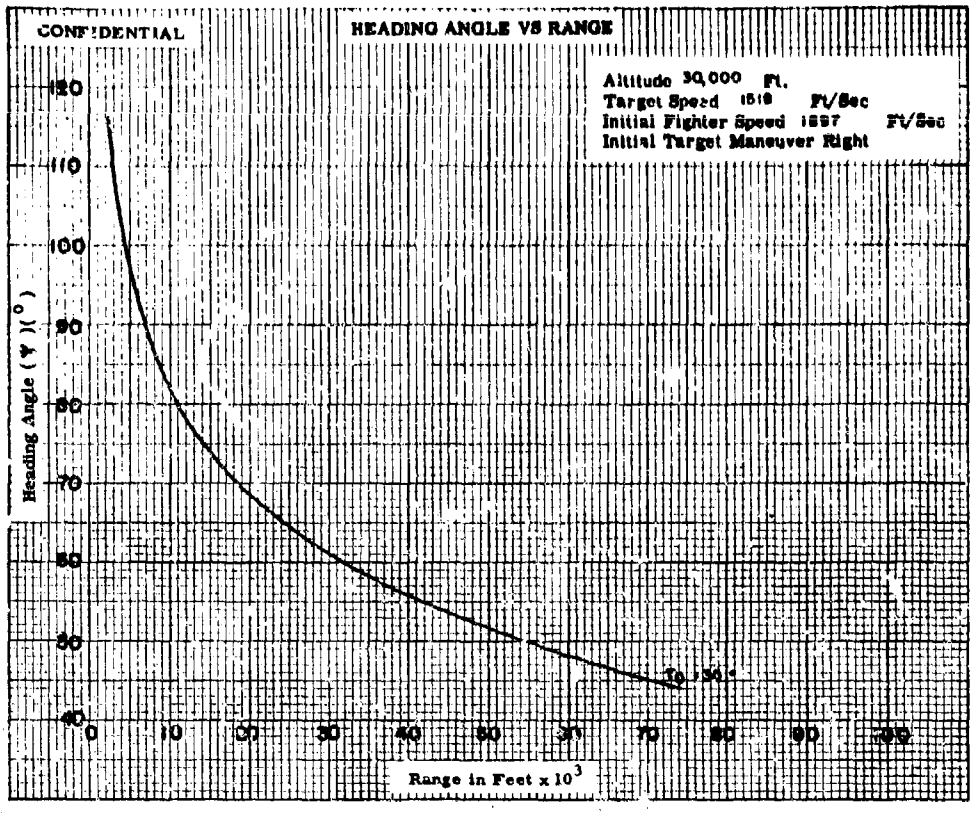

CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Target Aspect Angle (ψ)(°)
210
200
190
180
170
160
150
140
130
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-7c


CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Heading Angle (ψ)(°)
120
110
100
90
80
70
60
50
40
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

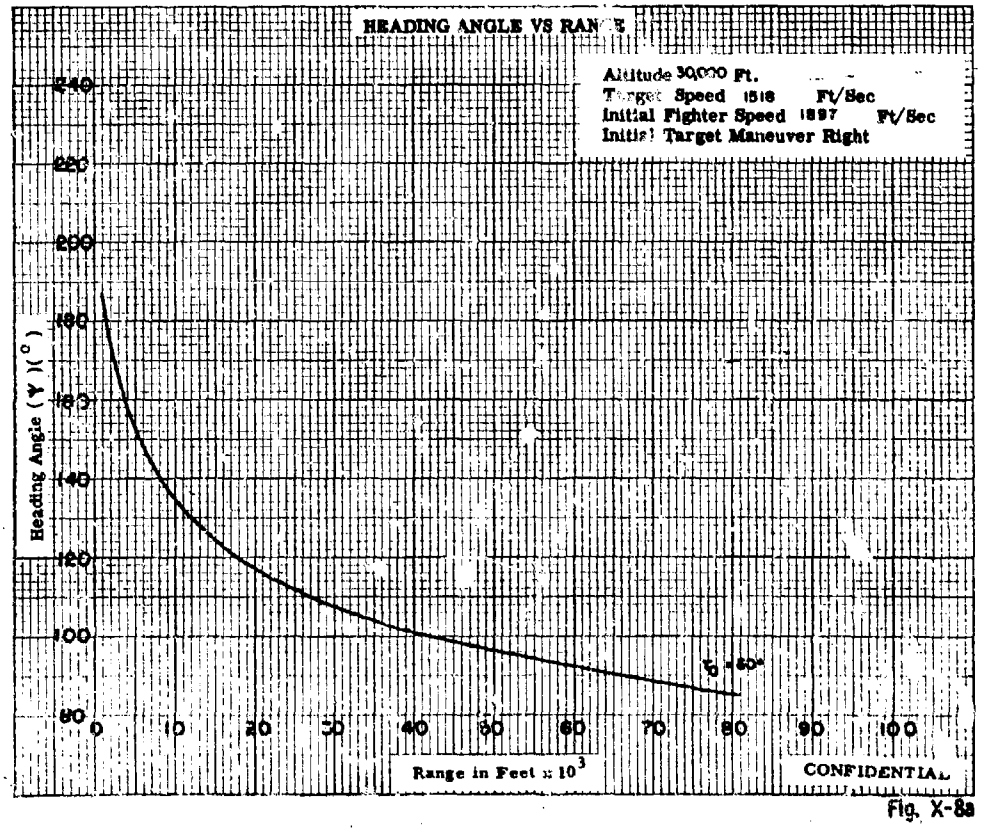
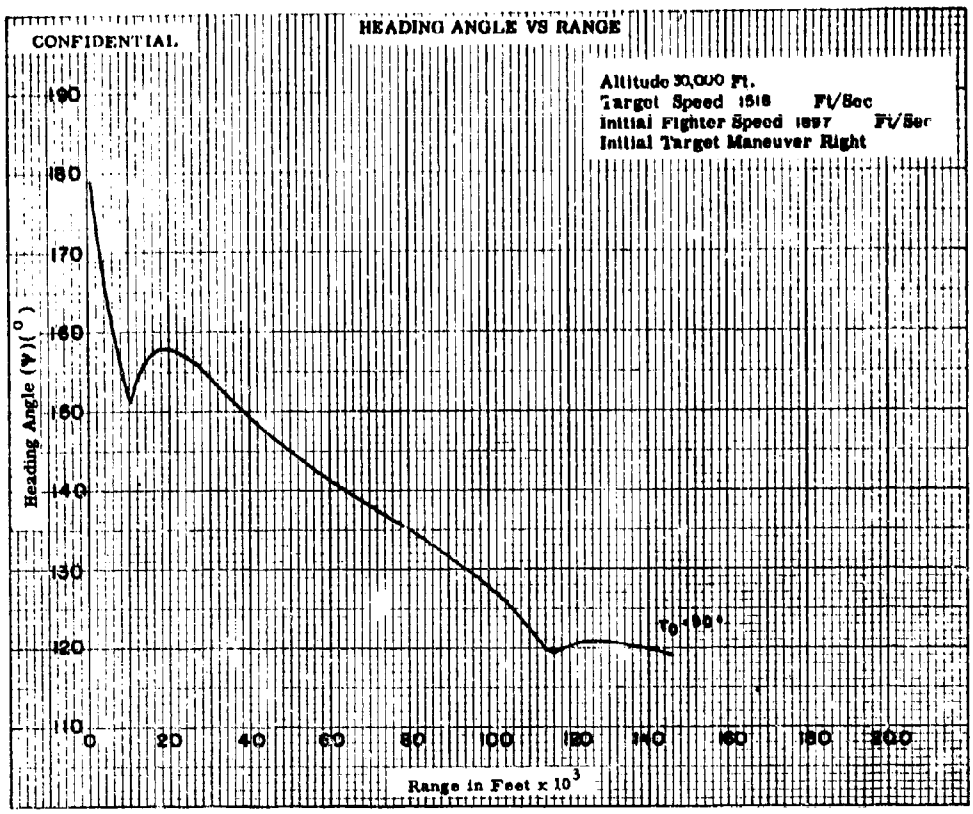

HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Heading Angle (ψ)(°)
240
220
200
180
160
140
120
100
80
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-8a


CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Heading Angle (Ψ)(°)
190
180
170
160
150
140
130
120
110
0
20
40
60
80
100
120
140
160
180
200
T_0 = 93°
Range in Feet x 10^3

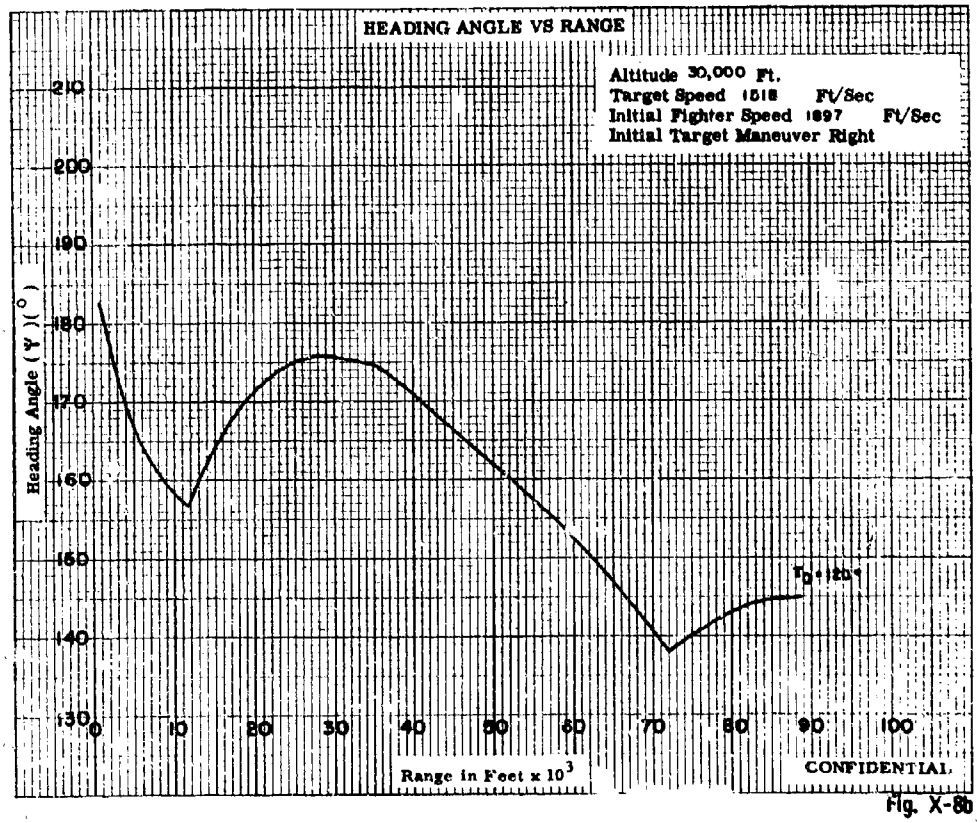

HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Heading Angle (Ψ)(°)
210
200
190
180
170
160
150
140
130
0
10
20
30
40
50
60
70
80
90
100
T_0 = 124°
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-8b

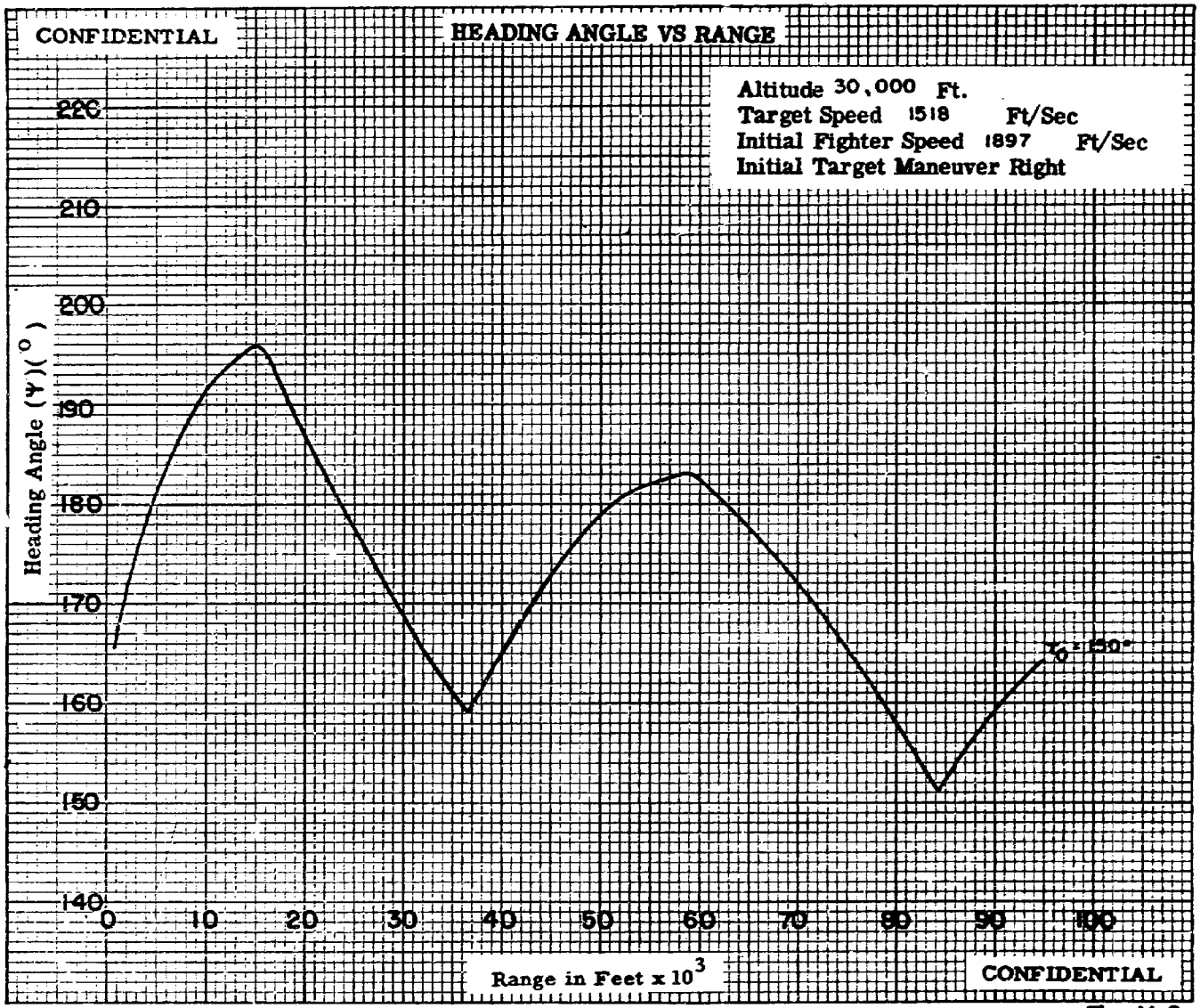
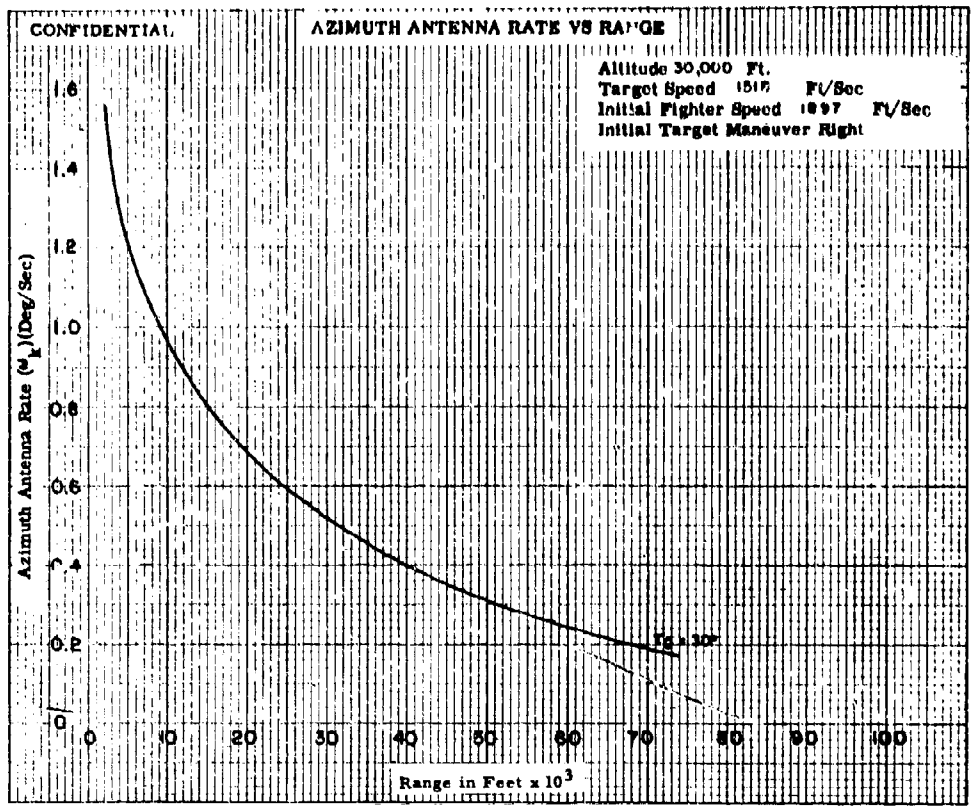

CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
220
210
200
190
180
170
160
150
140
Heading Angle (Ψ)(°)
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
$\psi_0 = 150°$
CONFIDENTIAL

Fig. X-8c


CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1515 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Azimuth Antenna Rate ($\dot{\psi}_k$)(Deg/Sec)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
γ_g = 30°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

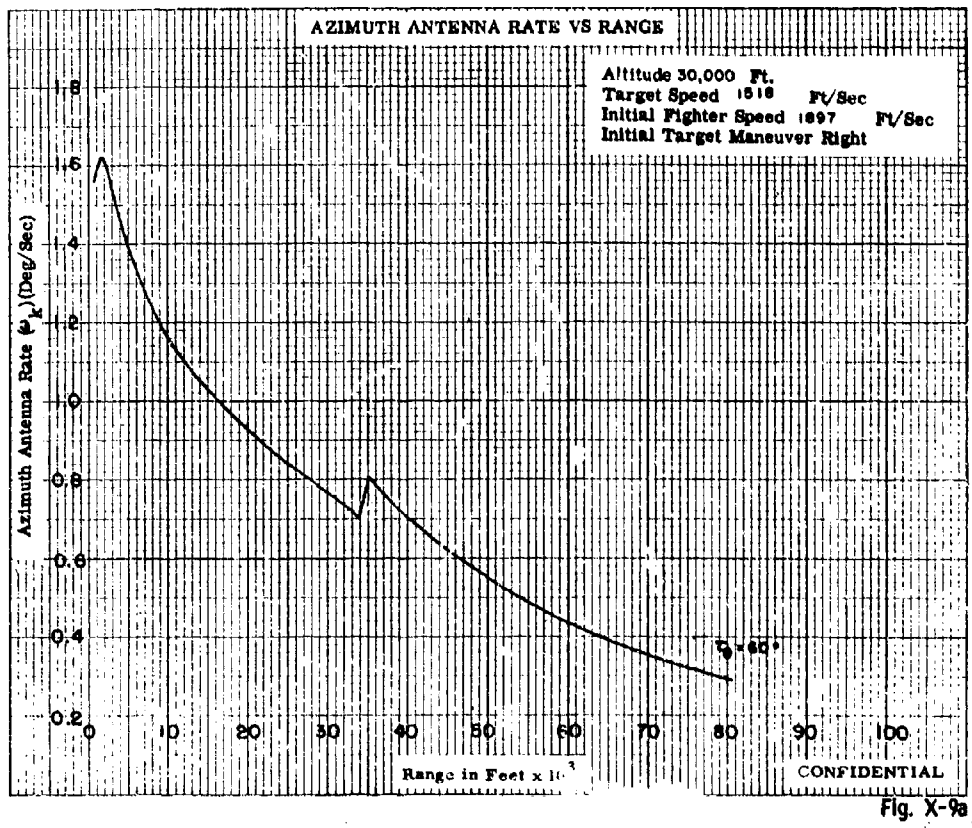
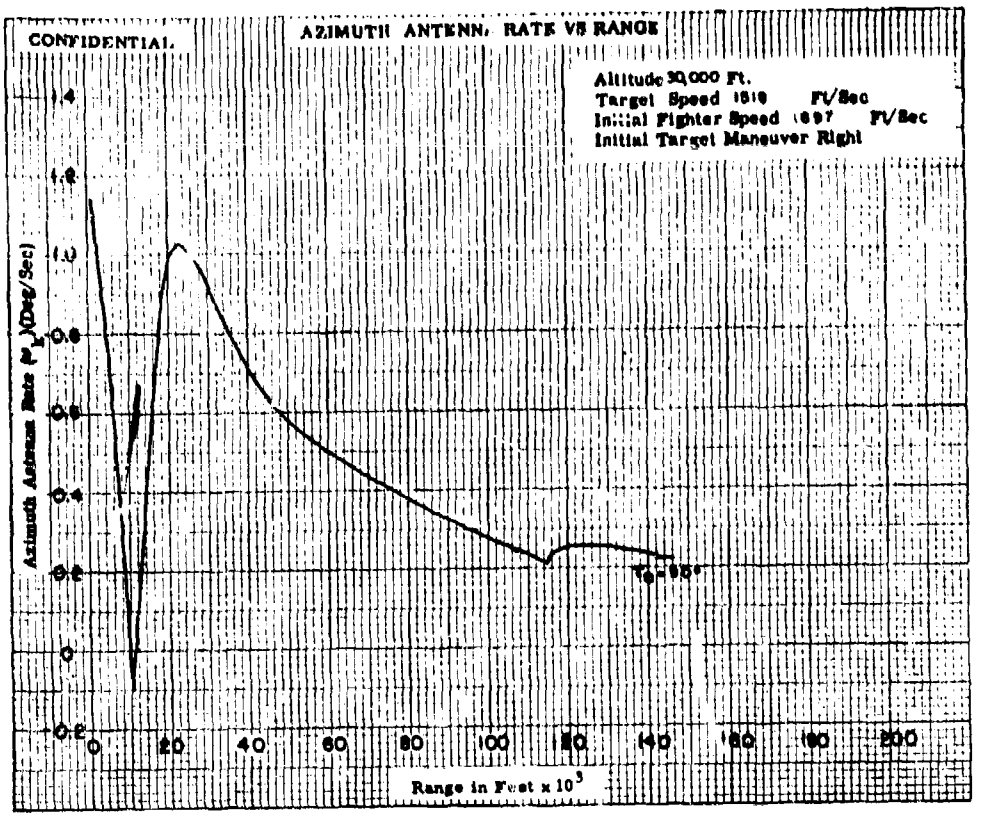

AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1515 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Azimuth Antenna Rate ($\dot{\psi}_k$)(Deg/Sec)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
γ_g = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-9a


AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1097 Ft/Sec
Initial Target Maneuver Right
Azimuth Antenna Rate (ω_k)(Deg/Sec)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

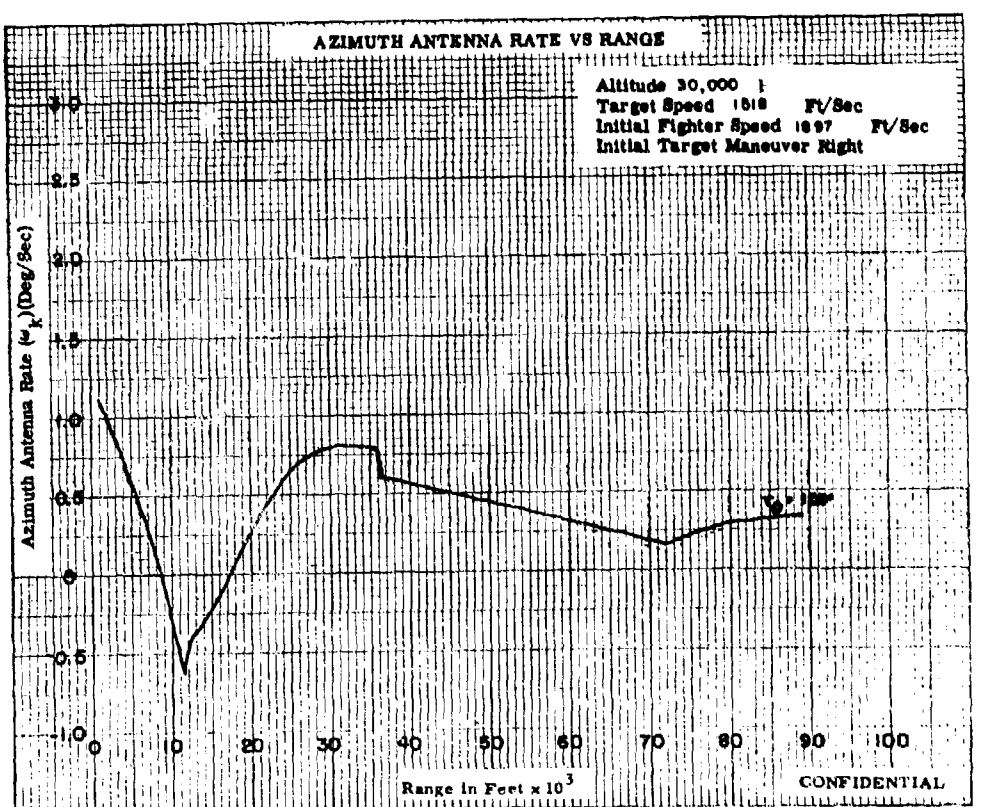

AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1097 Ft/Sec
Initial Target Maneuver Right
Azimuth Antenna Rate (ω_k)(Deg/Sec)
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
-1.0
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-9b

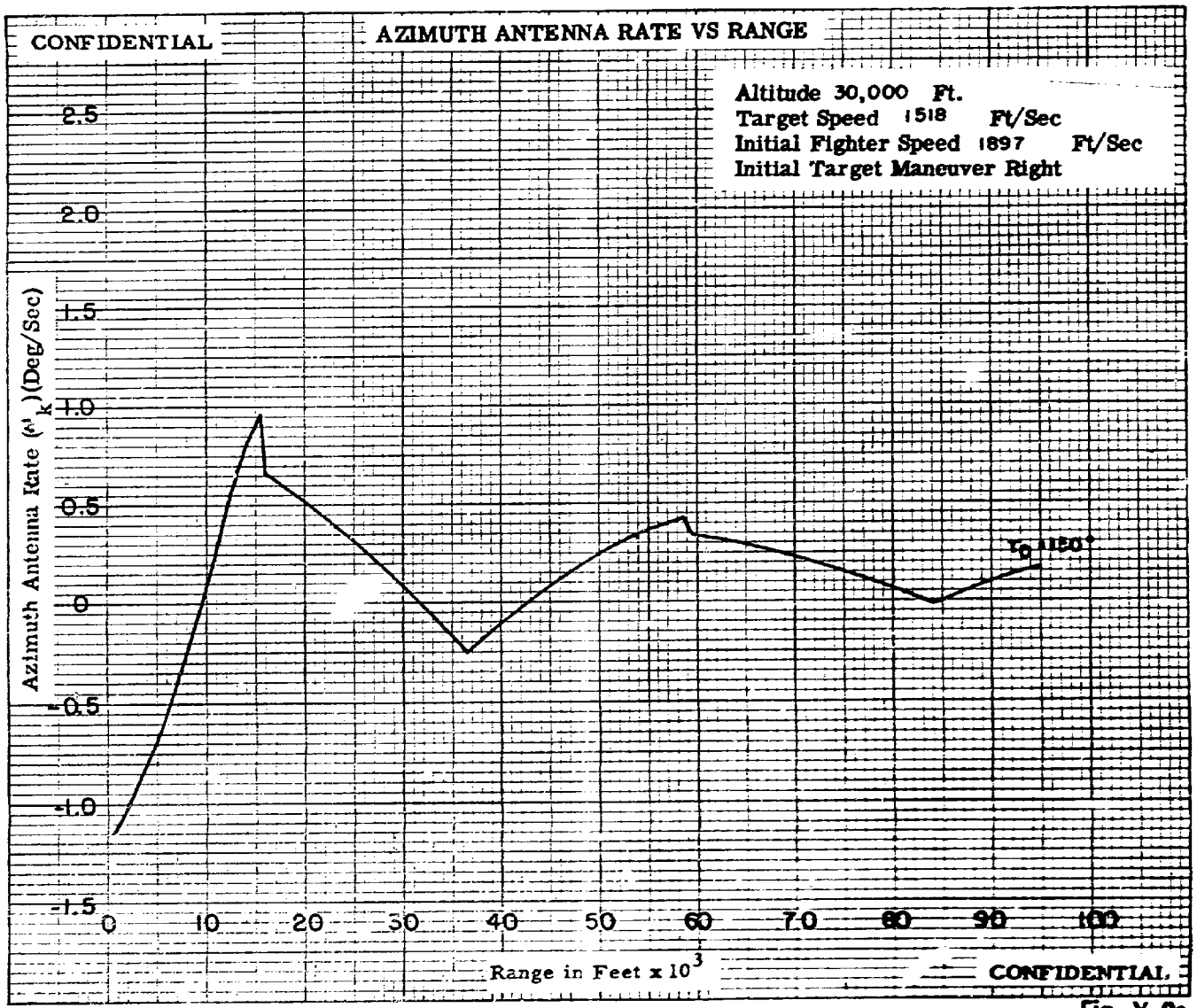

CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Azimuth Antenna Rate ($\dot{\lambda}'_k$) (Deg/Sec)
2.5
2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
T_0 1120*
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-9c

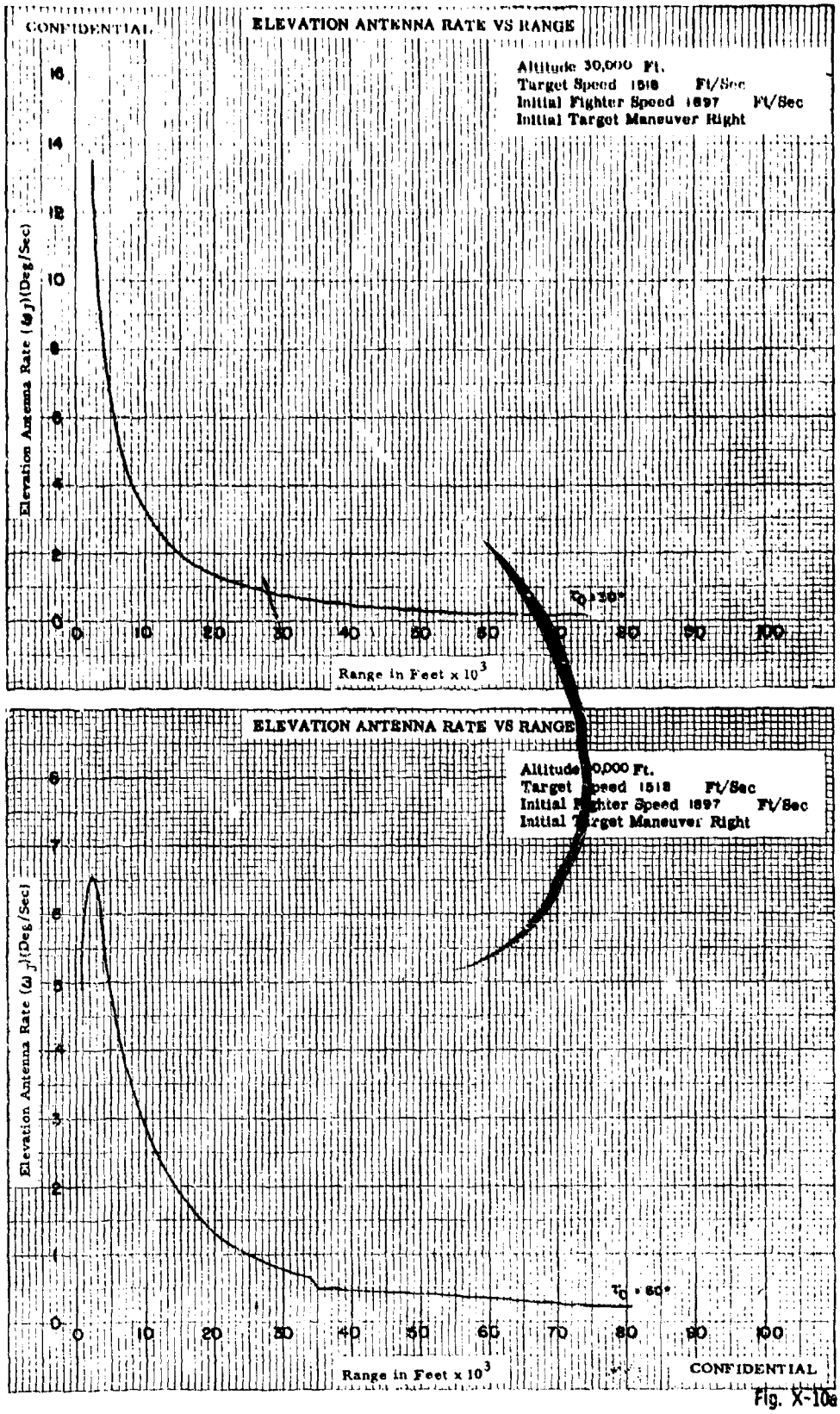
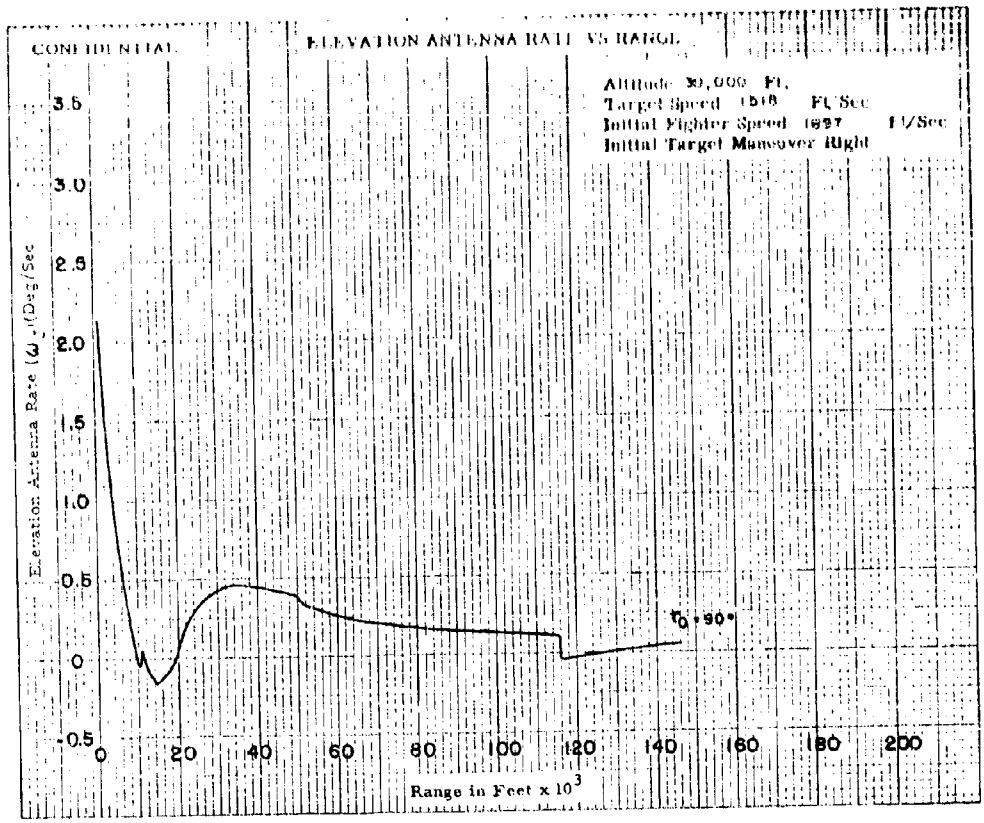

ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Elevation Antenna Rate (ωy)(Deg/Sec)
Range in Feet x 10^3
τ_0 = 30°
ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Elevation Antenna Rate (ωy)(Deg/Sec)
Range in Feet x 10^3
τ_0 = 60°

Fig. X-10a


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Elevation Antenna Rate (ω E)(Deg/Sec
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
T0 = 90°

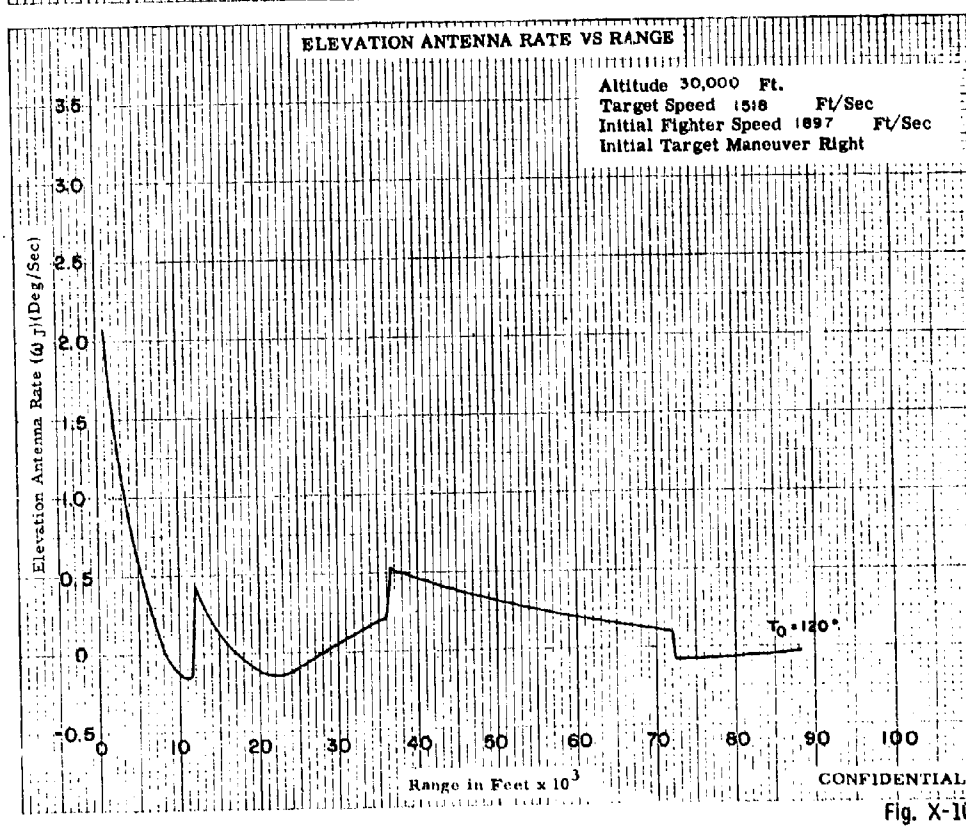

ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Elevation Antenna Rate (ω E)(Deg/Sec)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
-0.5
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
T0 = 120°
CONFIDENTIAL

Fig. X-10b

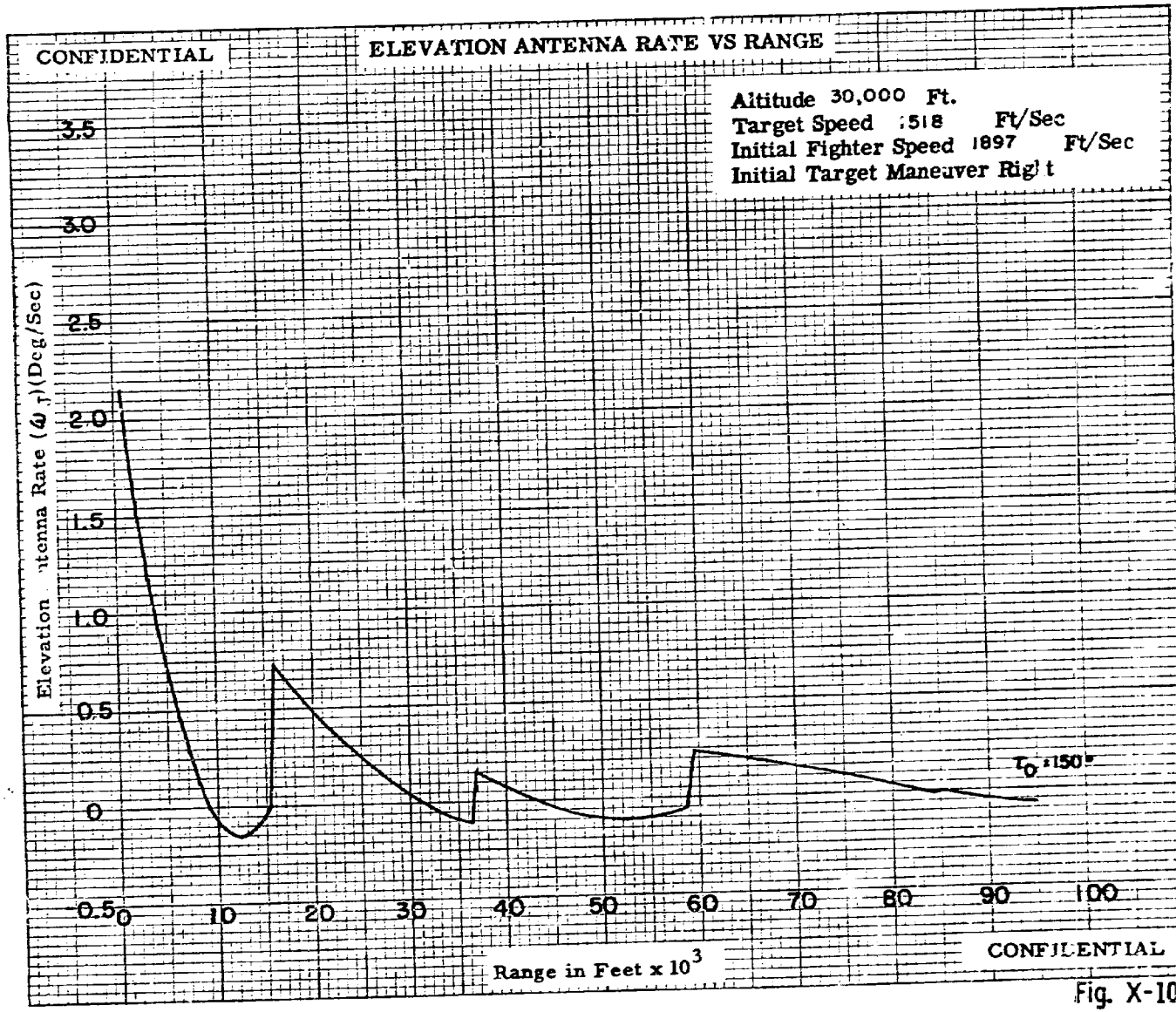
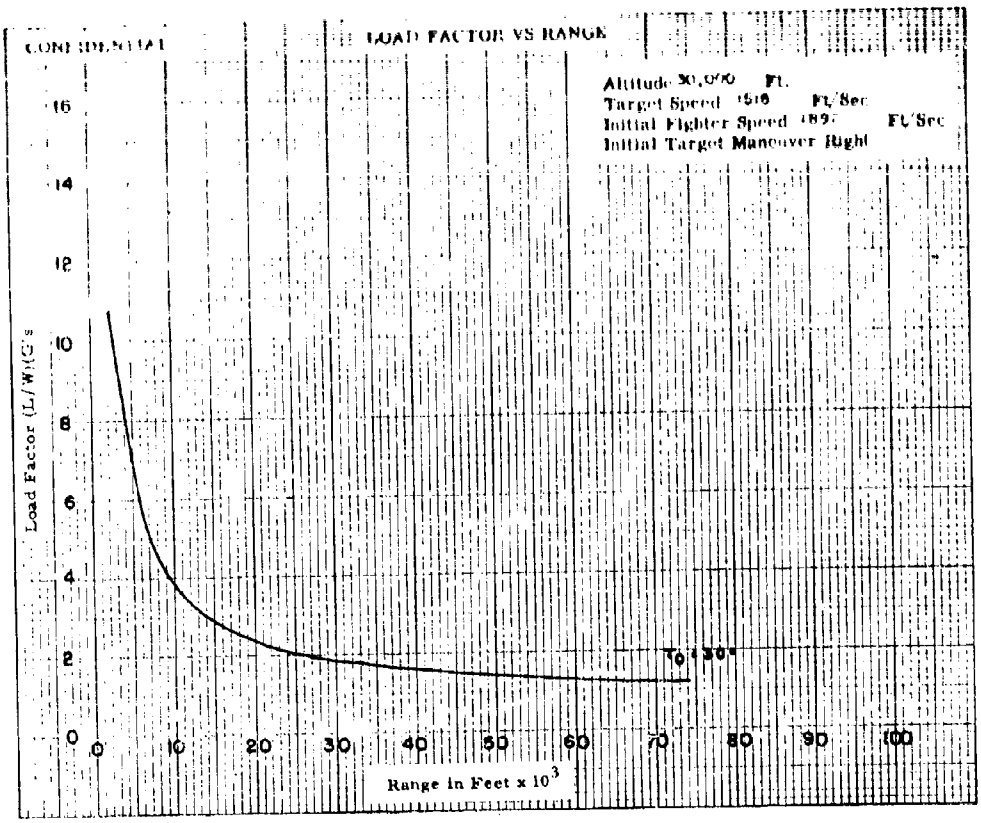

CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Elevation Antenna Rate (ω_E) (Deg/Sec)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0.5
0
10
20
30
40
50
60
70
80
90
100
τ_0 = 150
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-10c


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Load Factor (L/W)(G's)
Range in Feet x 10^3
T_0 = 30°

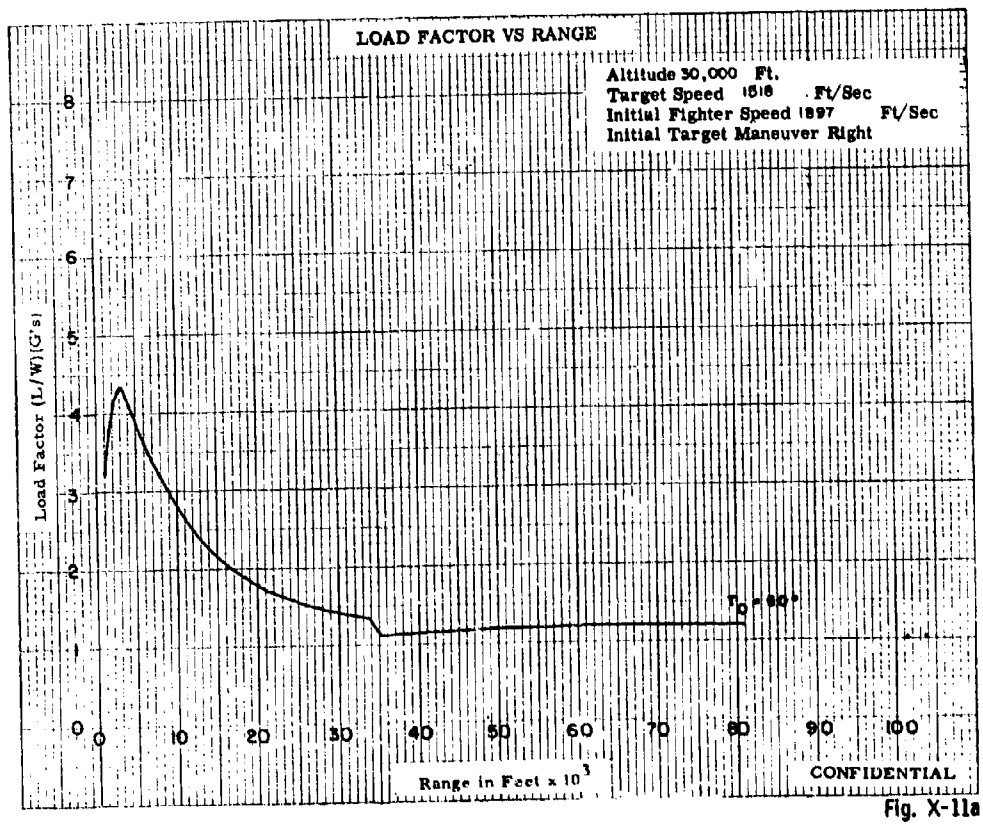
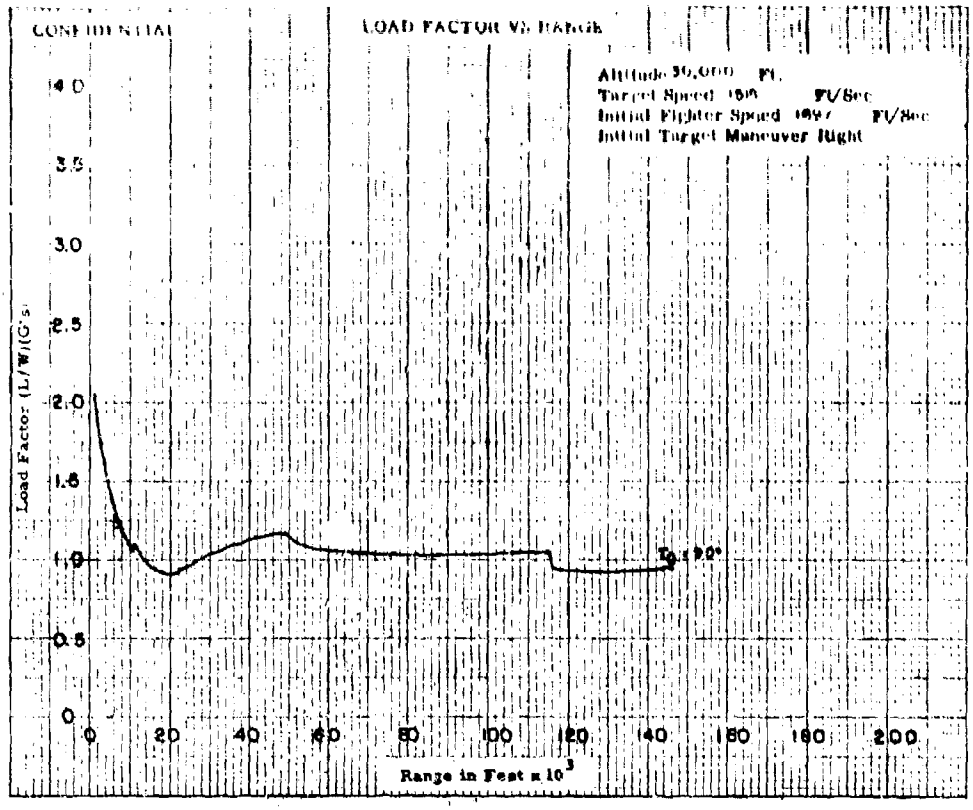

LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Load Factor (L/W)(G's)
Range in Feet x 10^3
T_0 = 60°
CONFIDENTIAL

Fig. X-11a


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1516 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Target Maneuver Right
Load Factor (L/W)(G's)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

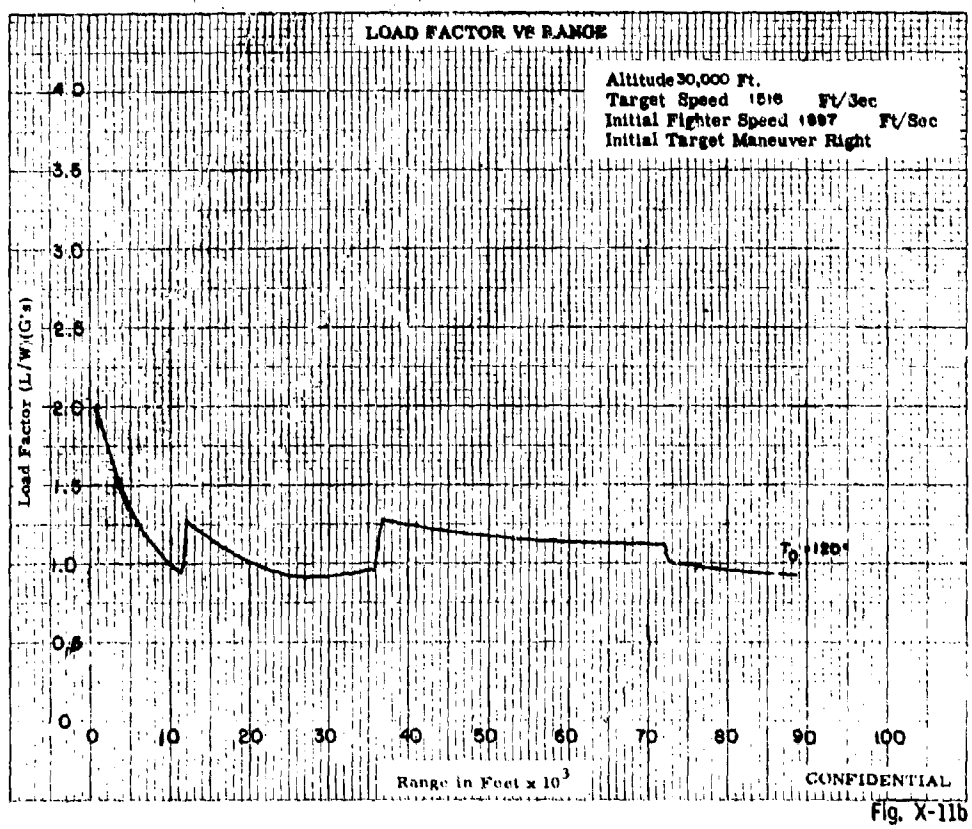

LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1516 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Target Maneuver Right
Load Factor (L/W)(G's)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-11b

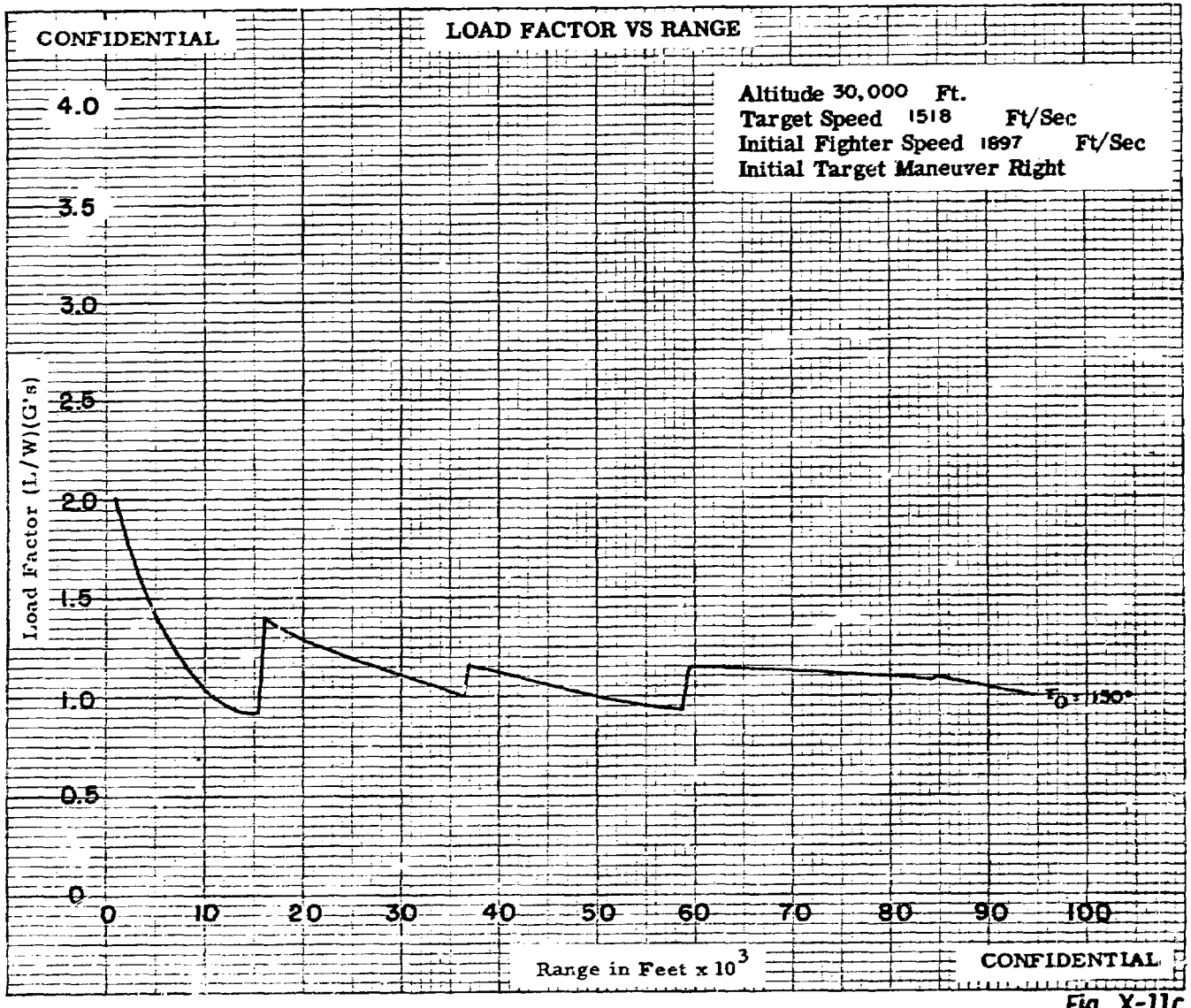
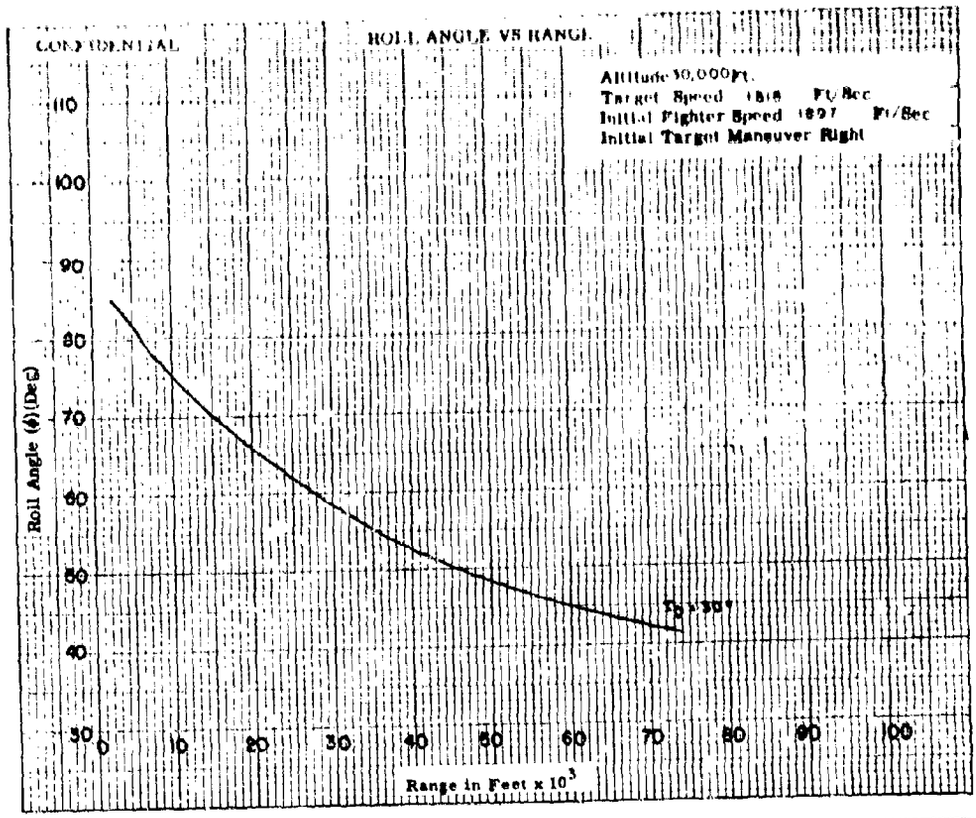

CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Load Factor (L/W)(G's)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
10
20
30
40
50
60
70
80
90
100
Ψ_0 = 150°
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-11c


CONFIDENTIAL
ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Target Maneuver Right
Roll Angle (ϕ) (Deg)
110
100
90
80
70
60
50
40
30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10³
T_D = 30°

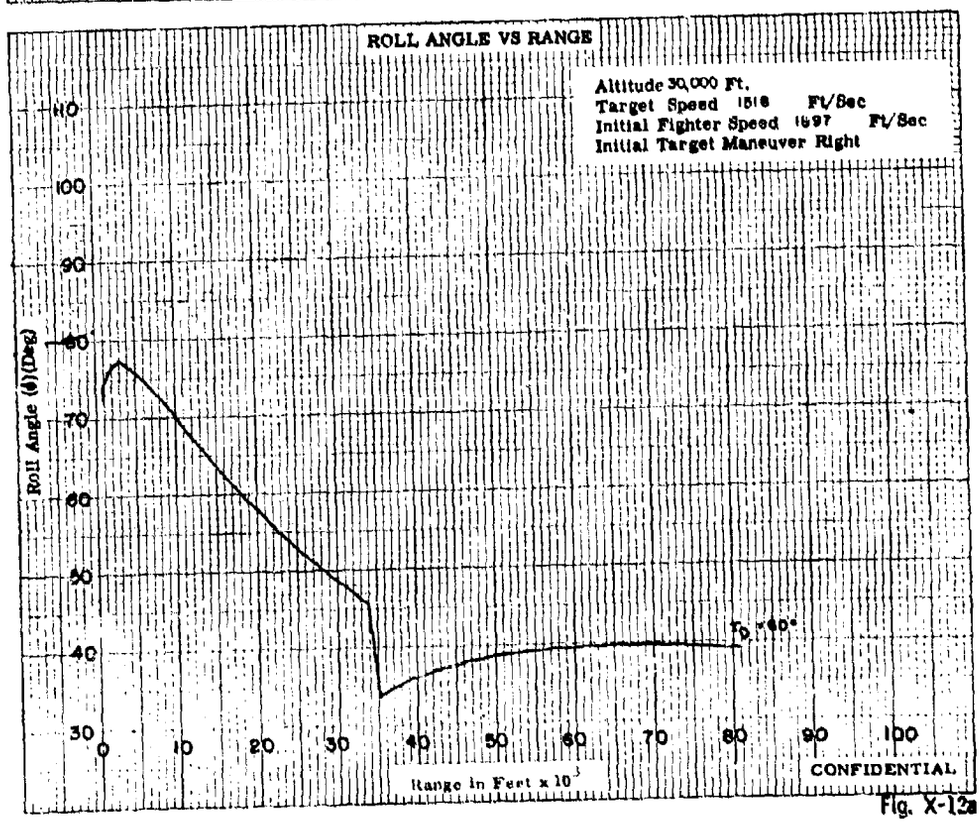
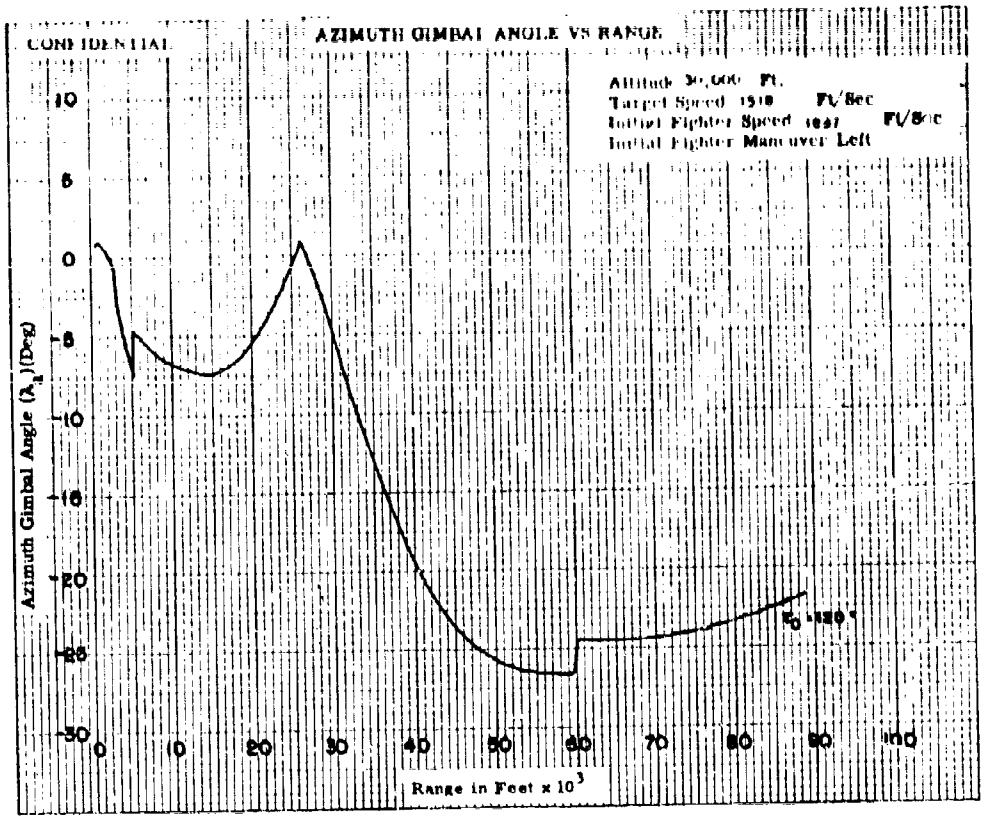

ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Target Maneuver Right
Roll Angle (ϕ) (Deg)
110
100
90
80
70
60
50
40
30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10³
T_D = 60°
CONFIDENTIAL

Fig. X-12a


AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_z)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
ψ_0 = 120°

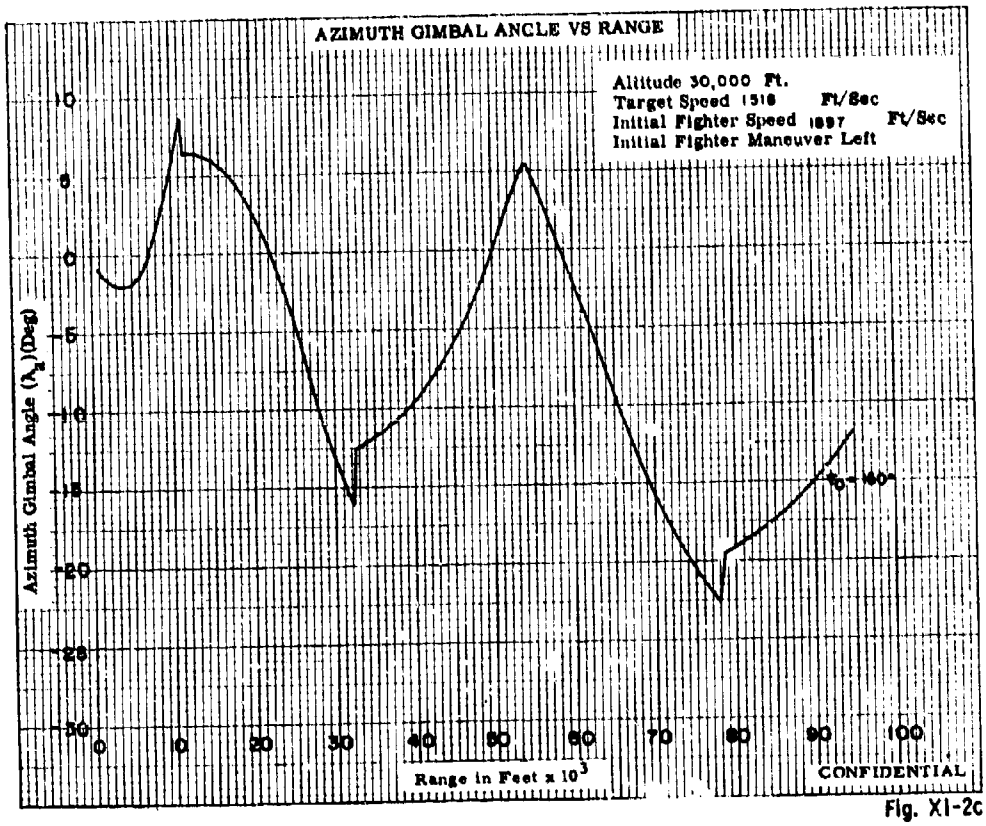
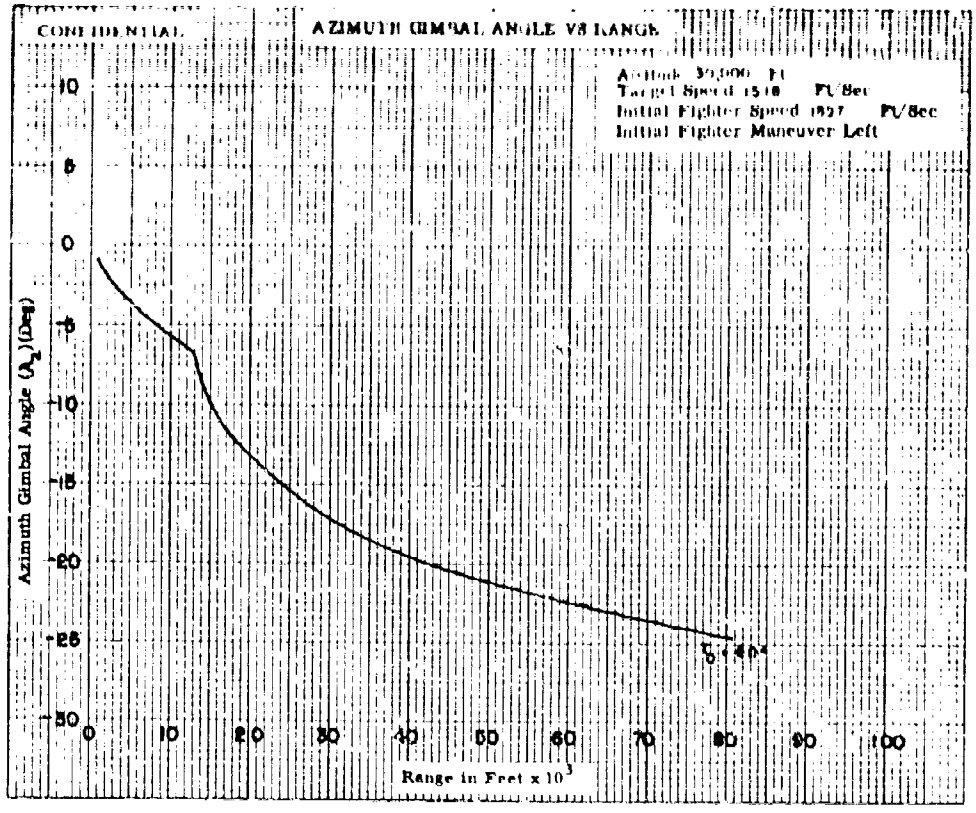

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_z)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
ψ_0 = 180°
CONFIDENTIAL

Fig. XI-2c


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_2)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

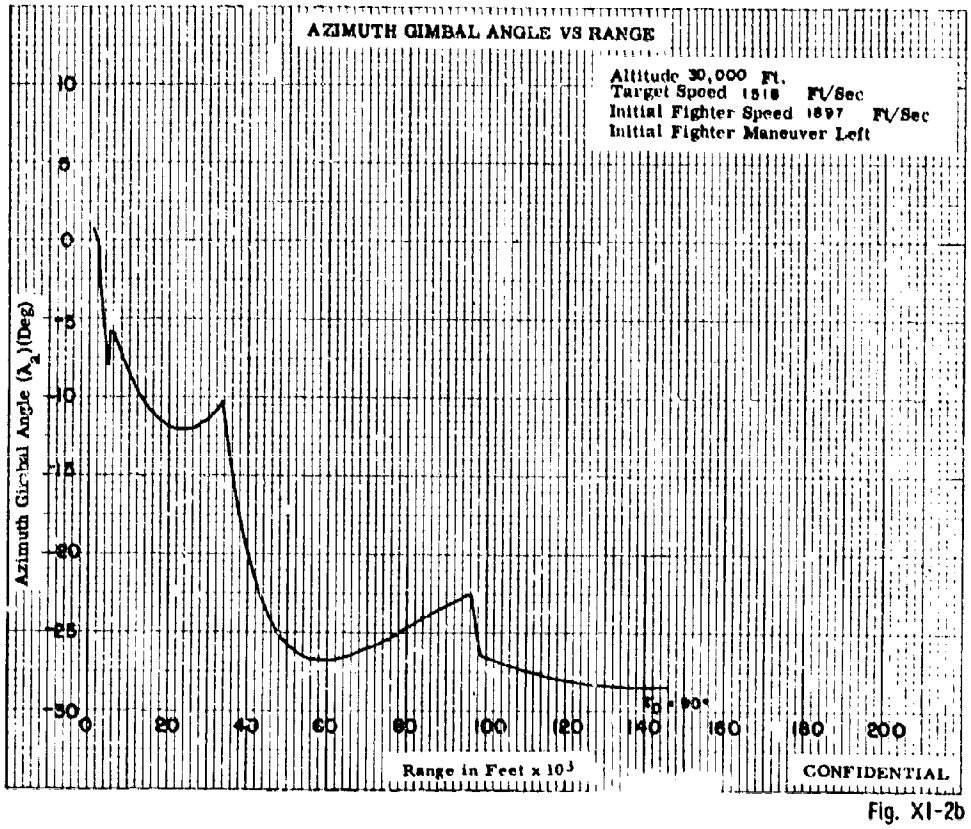
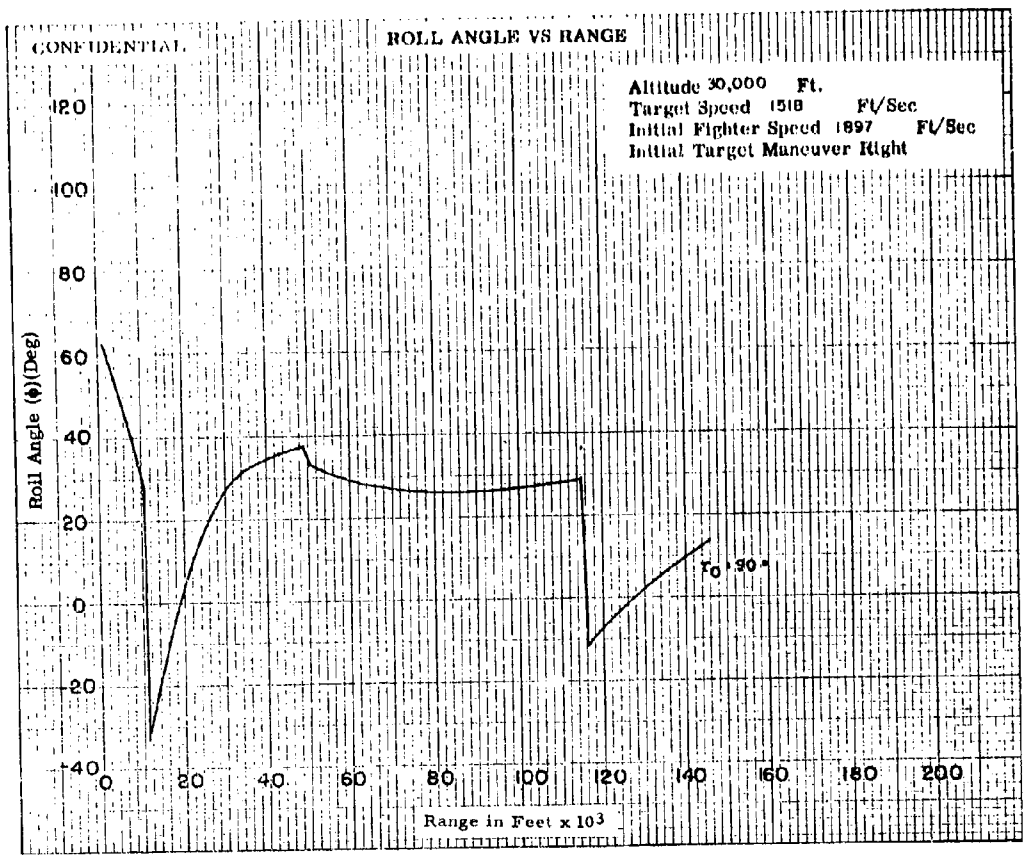

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_2)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-2b


CONFIDENTIAL
ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Roll Angle (φ)(Deg)
120
100
80
60
40
20
0
-20
-40
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10³
τ_0 = 90°

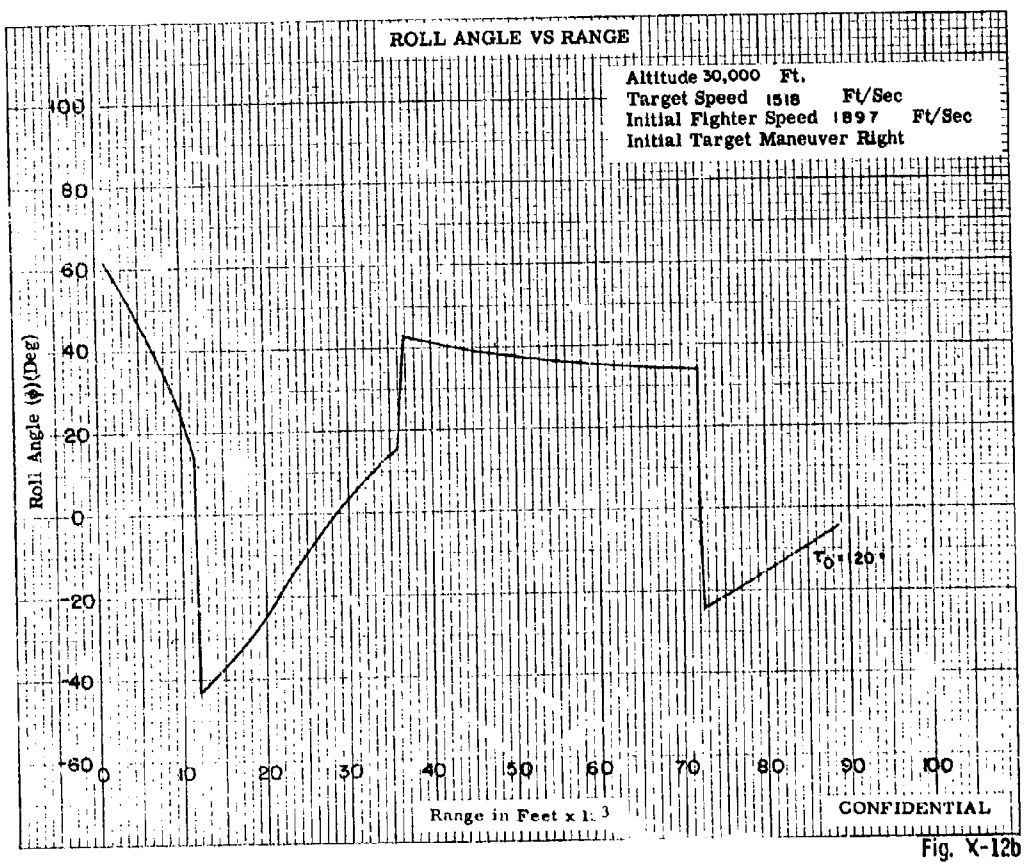

ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Roll Angle (φ)(Deg)
100
80
60
40
20
0
-20
-40
-60
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10³
τ_0 = 20°
CONFIDENTIAL

Fig. X-12b

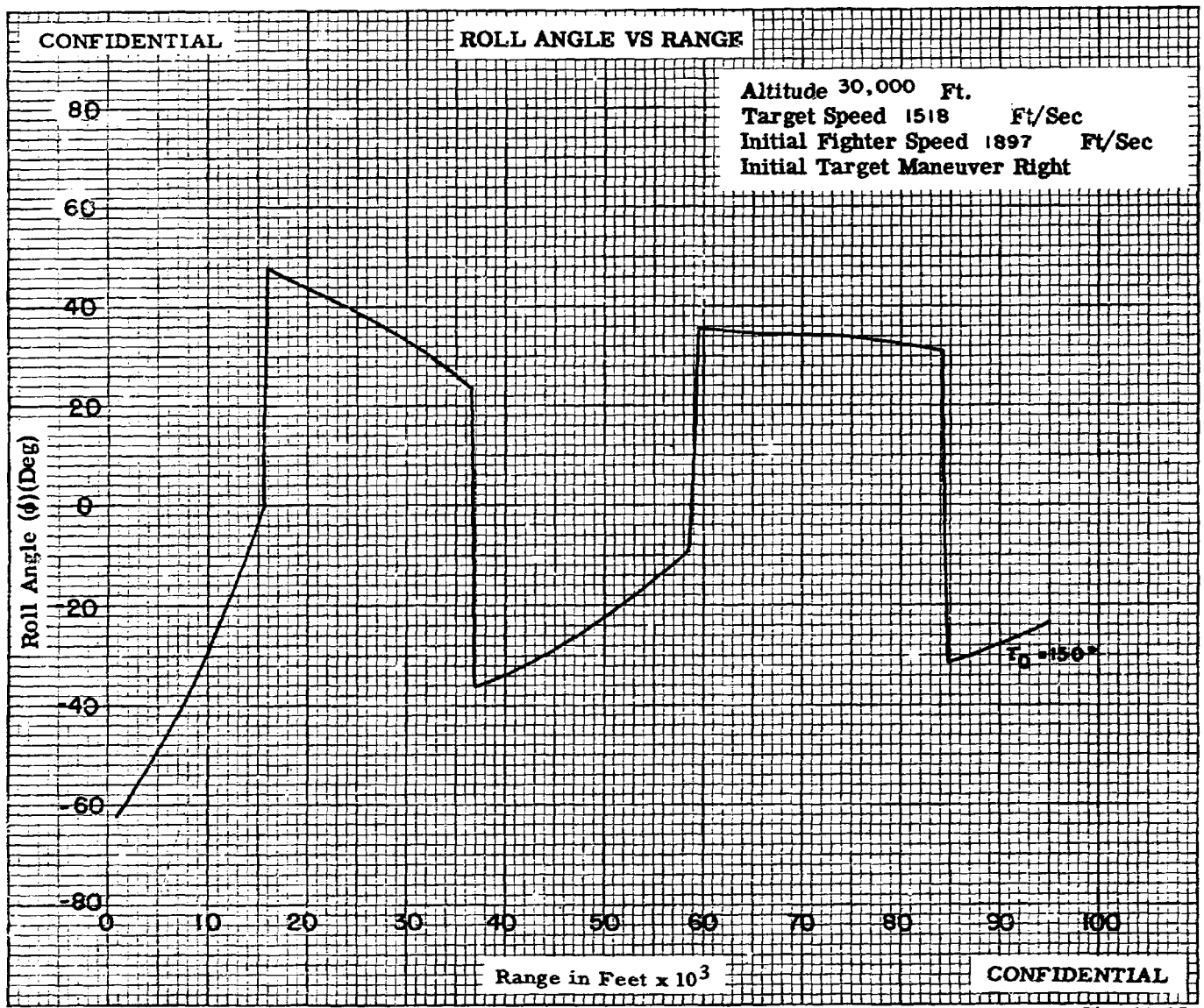
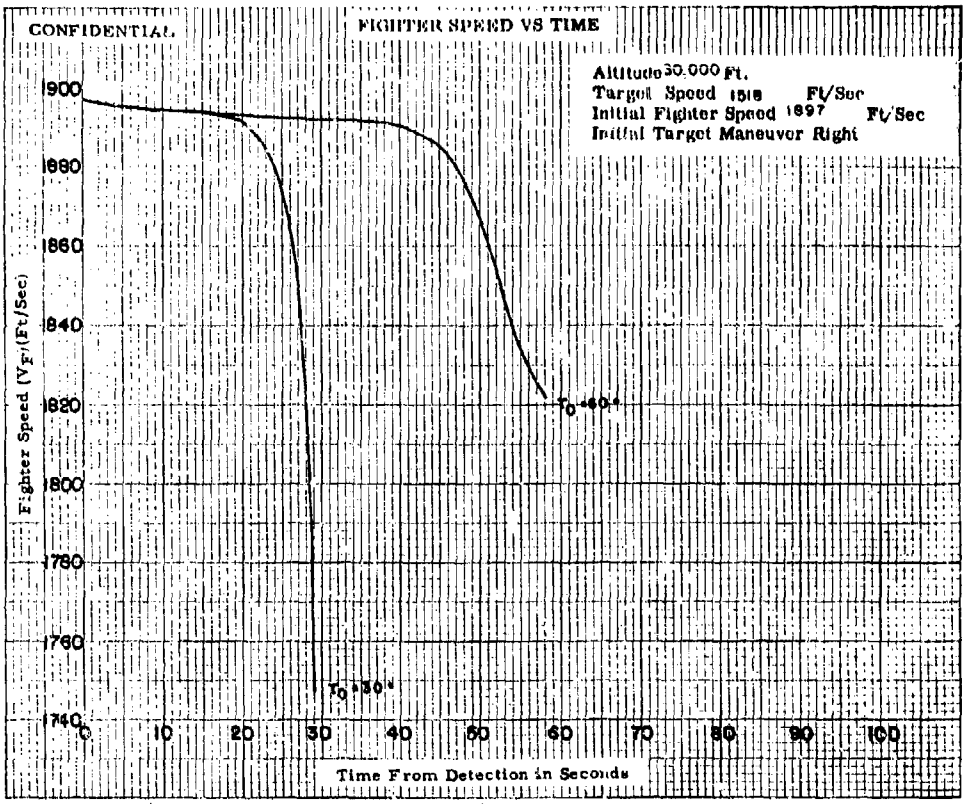

CONFIDENTIAL
ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
80
60
40
20
0
-20
-40
-60
-80
Roll Angle (ϕ)(Deg)
τ_D -150°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. X-12c


FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Fighter Speed (V_F) (Ft/Sec)
1900
1880
1860
1840
1820
1800
1780
1760
1740
γ_0 = 60°
γ_0 = 30°
0
10
20
30
40
50
60
70
80
90
100
Time From Detection in Seconds

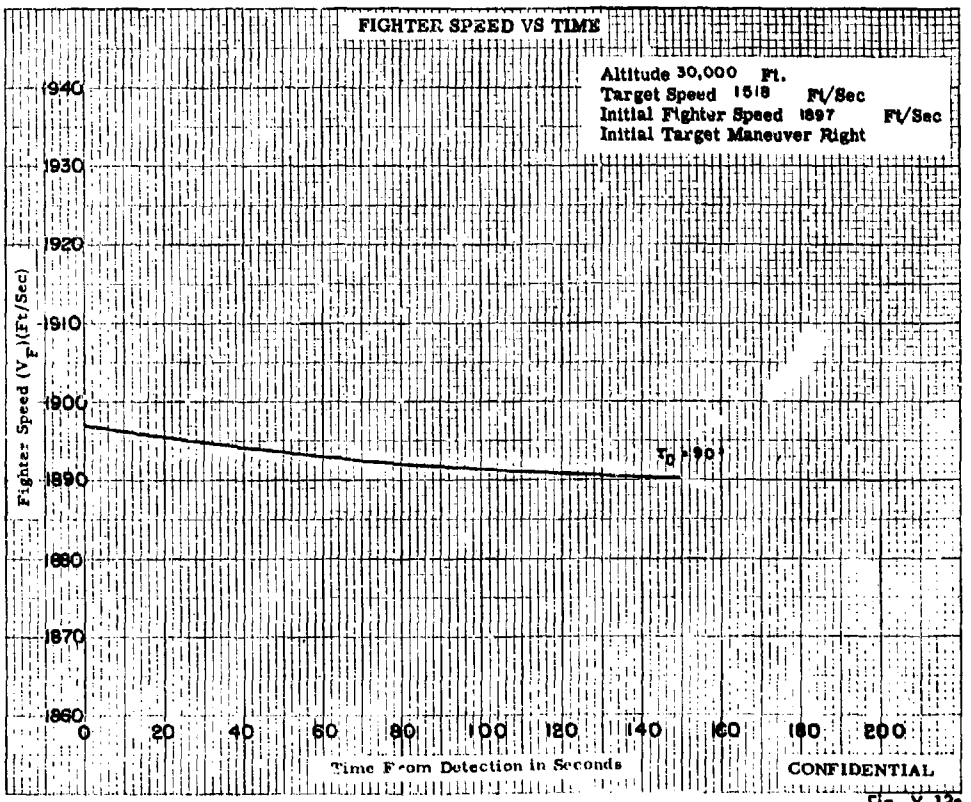
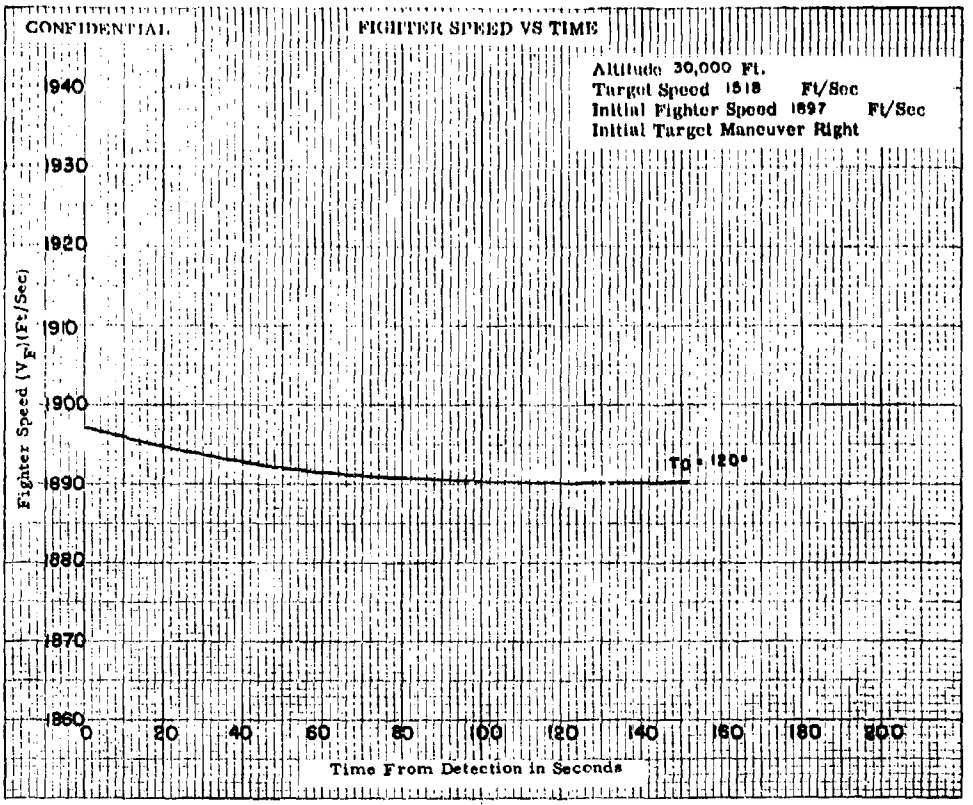

FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Fighter Speed (V_F) (Ft/Sec)
1940
1930
1920
1910
1900
1890
1880
1870
1860
γ_0 = 90°
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds

Fig. X-13a


FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Fighter Speed (V_F) (Ft/Sec)
1940
1930
1920
1910
1900
1890
1880
1870
1860
T_0 = 120°
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds

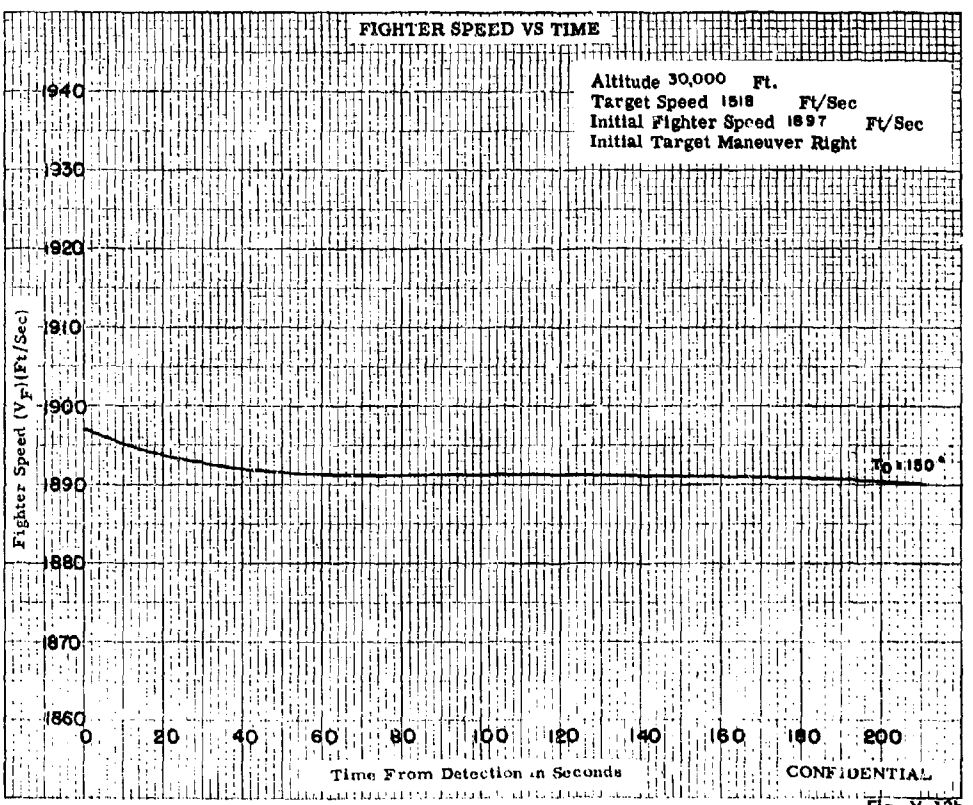
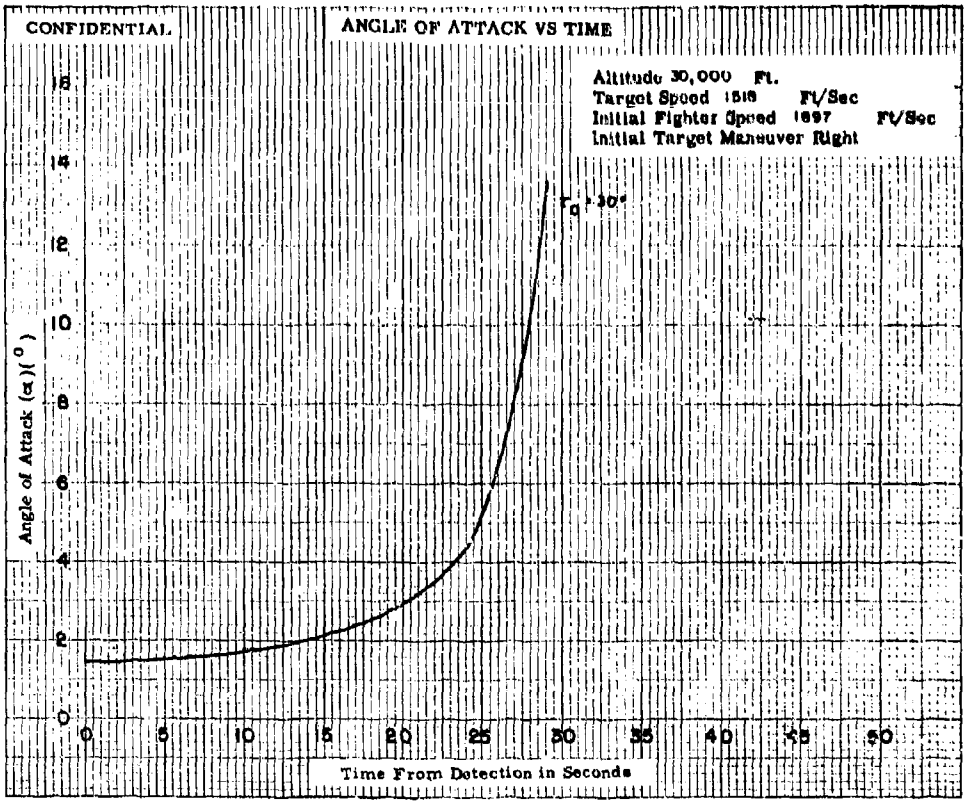

FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Fighter Speed (V_F) (Ft/Sec)
1940
1930
1920
1910
1900
1890
1880
1870
1860
T_0 = 150°
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds

Fig. X-13b


CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
τ_0 = 30°
Angle of Attack (α)(°)
0 2 4 6 8 10 12 14 16
0 5 10 15 20 25 30 35 40 45 50
Time From Detection in Seconds

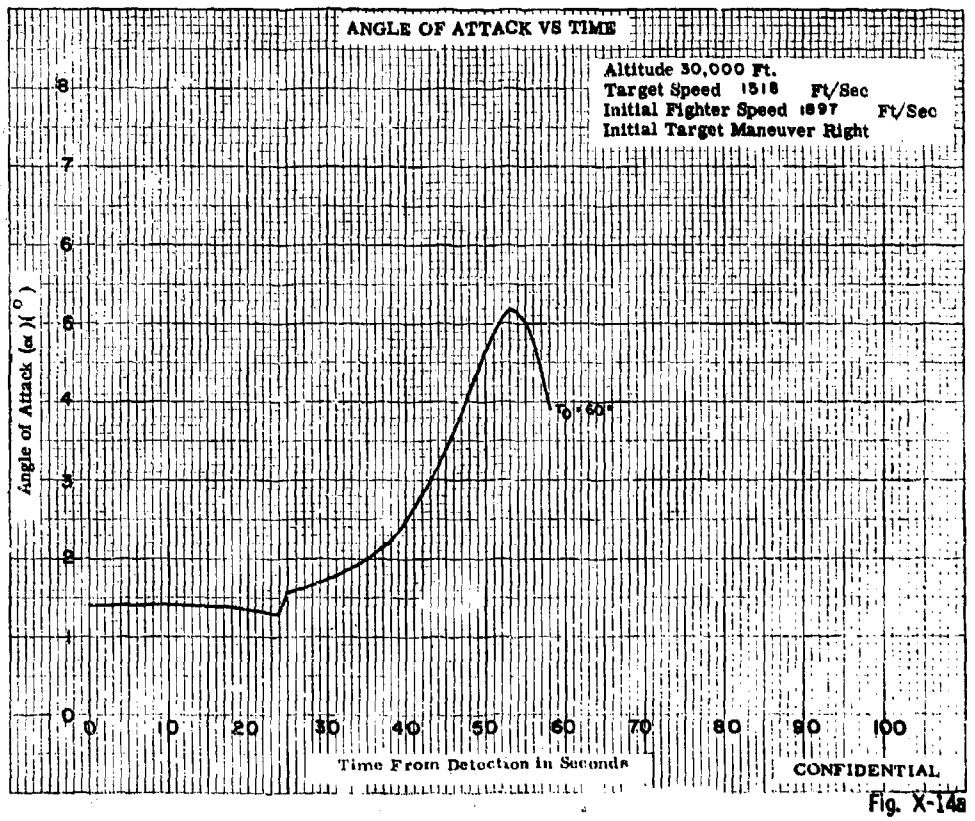
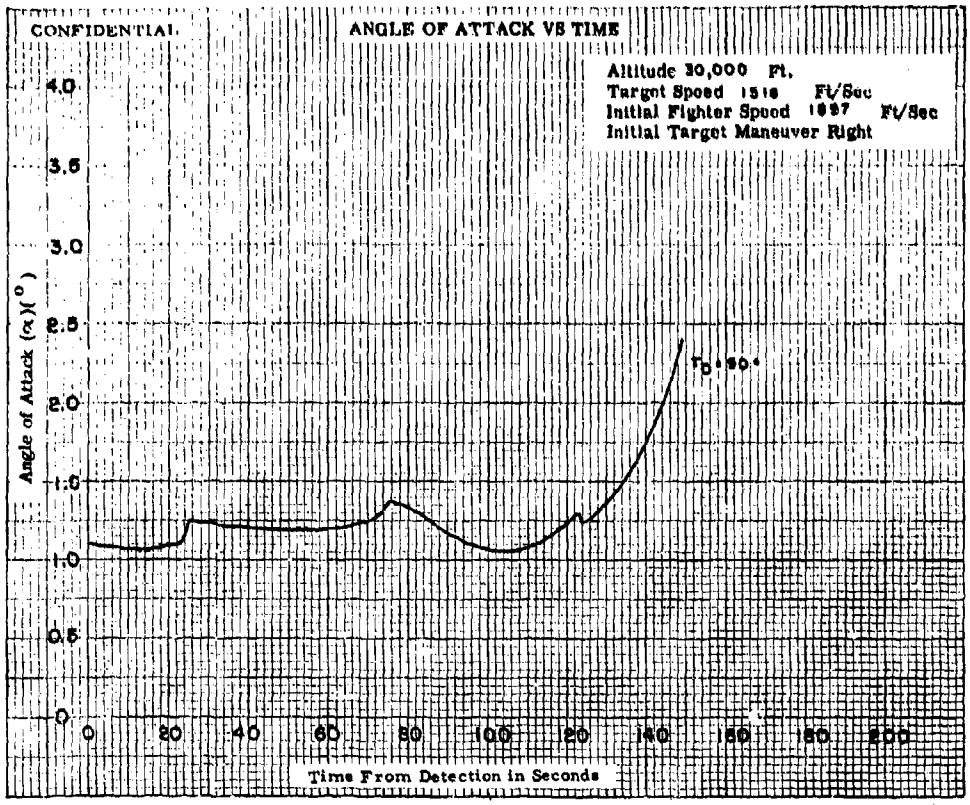

ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
τ_0 = 60°
Angle of Attack (α)(°)
0 1 2 3 4 5 6 7 8
0 10 20 30 40 50 60 70 80 90 100
Time From Detection in Seconds
CONFIDENTIAL

Fig. X-14a


CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Angle of Attack (α)(°)
4.0
3.5
3.0
2.5
2.0
1.0
0.5
0
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds

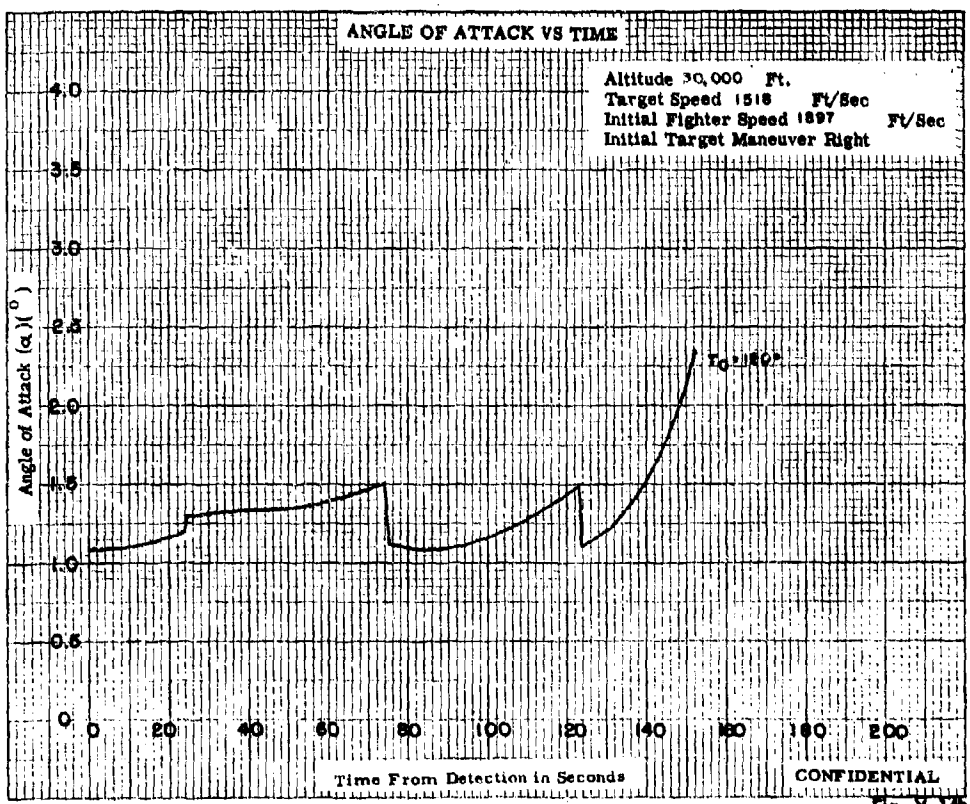

ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Angle of Attack (α)(°)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds
CONFIDENTIAL

Fig. X-14b

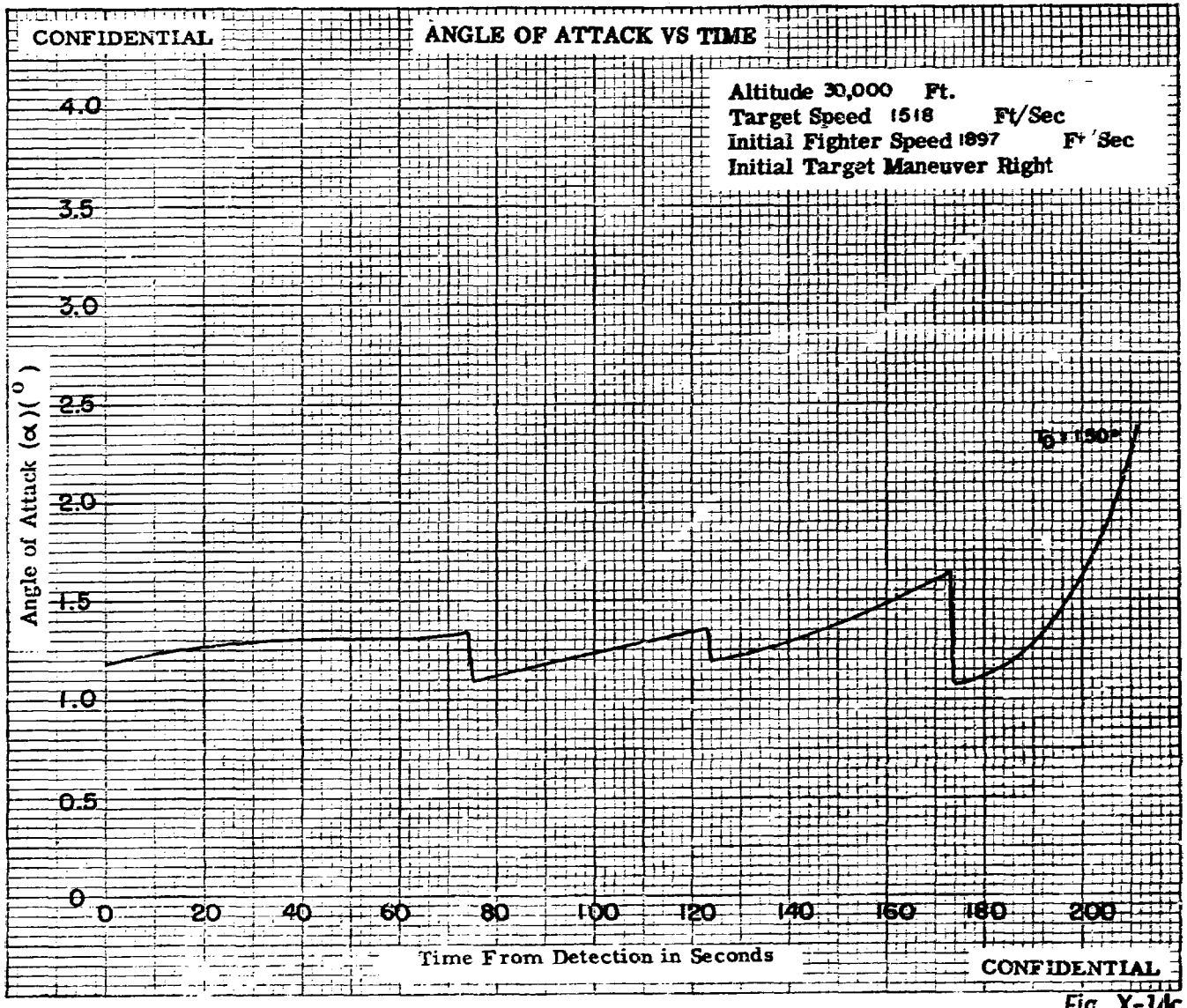
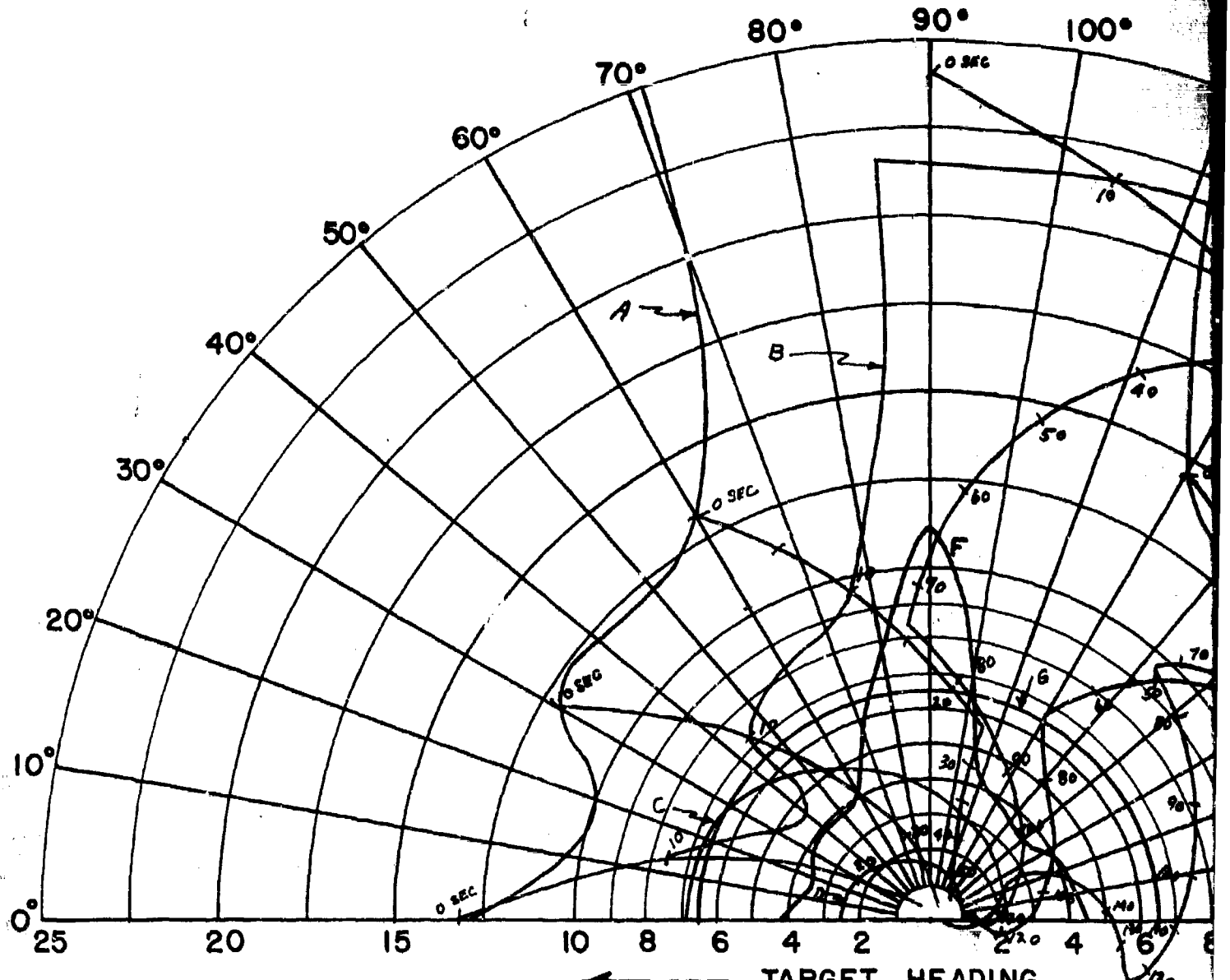

CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Target Maneuver Right
Angle of Attack (α)(°)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds
CONFIDENTIAL

Fig. X-14c



TARGET HEADING

V_F = 1897 FT/SEC (F4H-1)(F8U-3)

V_T = 1518 FT/SEC

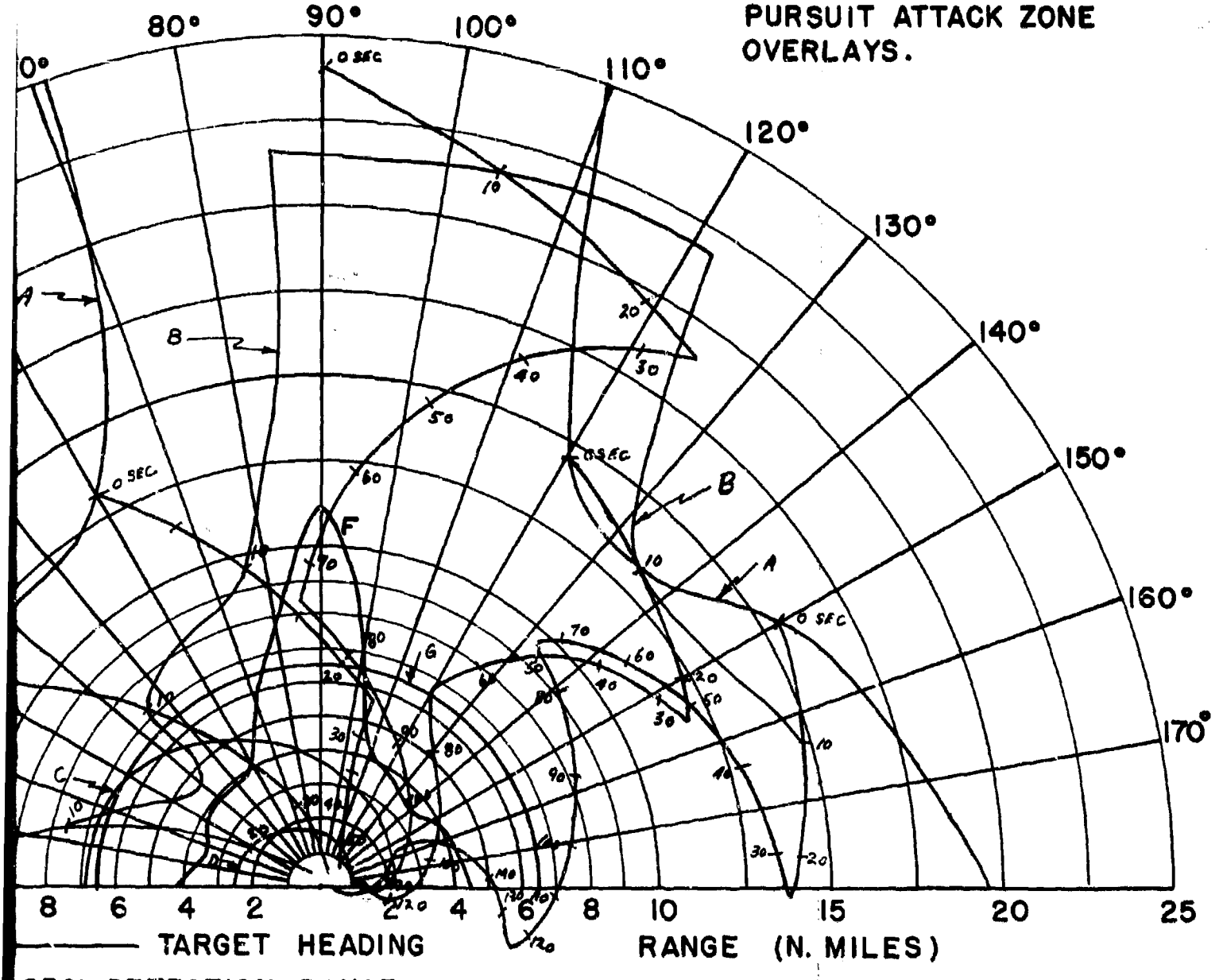
ALTITUDE = 30,000 FT.

MANEUVERING TARGET - IN TARGET COORDINATES
INITIAL LEFT TURN

A - 85% DETECTION RANGE
B - LOCK-ON RANGE (10 SEC. LOCK-ON T
C - SPARROW III MAX. AERODYNAMIC RA
D - SPARROW III MIN. AERODYNAMIC RA

F - 90% SPARROW III SEEKER LOCK-O
G - 6.5 N.M. INTERLOCK

FIG. XI - CO-ALTITUDE LEAD PURSUIT ATTACK ZONE OVERLAYS.



85% DETECTION RANGE
LOCK-ON RANGE (10 SEC. LOCK-ON TIME)
SPARROW III MAX. AERODYNAMIC RANGE
SPARROW III MIN. AERODYNAMIC RANGE

90% SPARROW III SEEKER LOCK-ON RANGE
6.5 N.M. INTERLOCK

CONFIDENTIAL

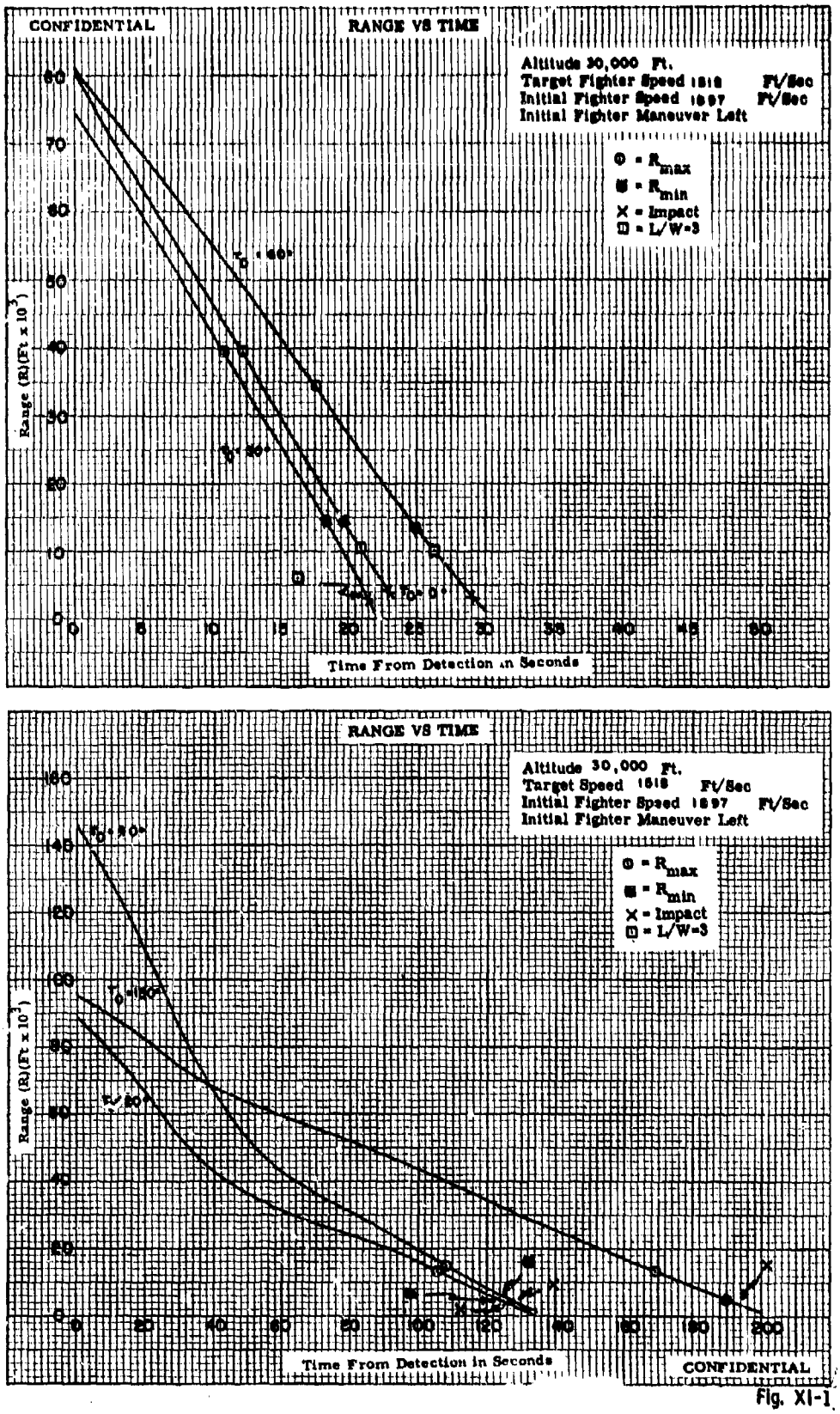
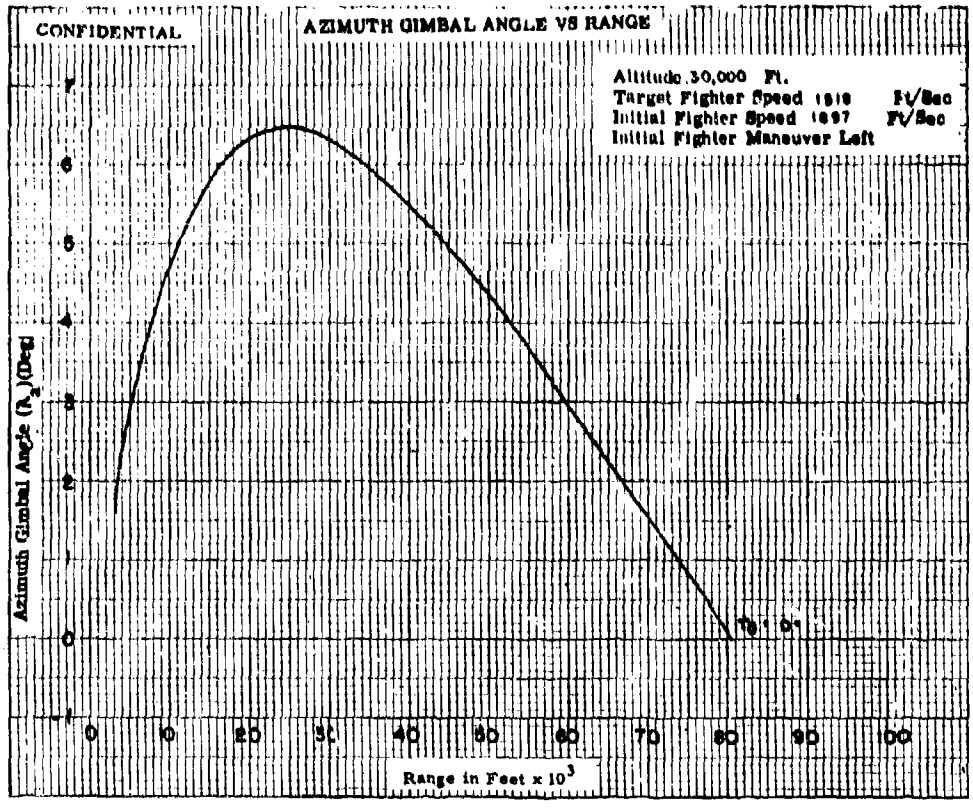

CONFIDENTIAL
RANGE VS TIME
Altitude 30,000 Ft.
Target Fighter Speed 1818 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
⊙ = R_{max}
■ = R_{min}
× = Impact
⊡ = L/W=3
ψ_o = 60°
ψ_o = 30°
ψ_o = 0°
Range (R)(Ft x 10^3)
Time From Detection in Seconds
RANGE VS TIME
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
⊙ = R_{max}
■ = R_{min}
× = Impact
⊡ = L/W=3
ψ_o = 90°
ψ_o = 150°
ψ_o = 180°
Range (R)(Ft x 10^3)
Time From Detection in Seconds
CONFIDENTIAL

Fig. XI-1


AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_z)(Deg)
Range in Feet x 10^3

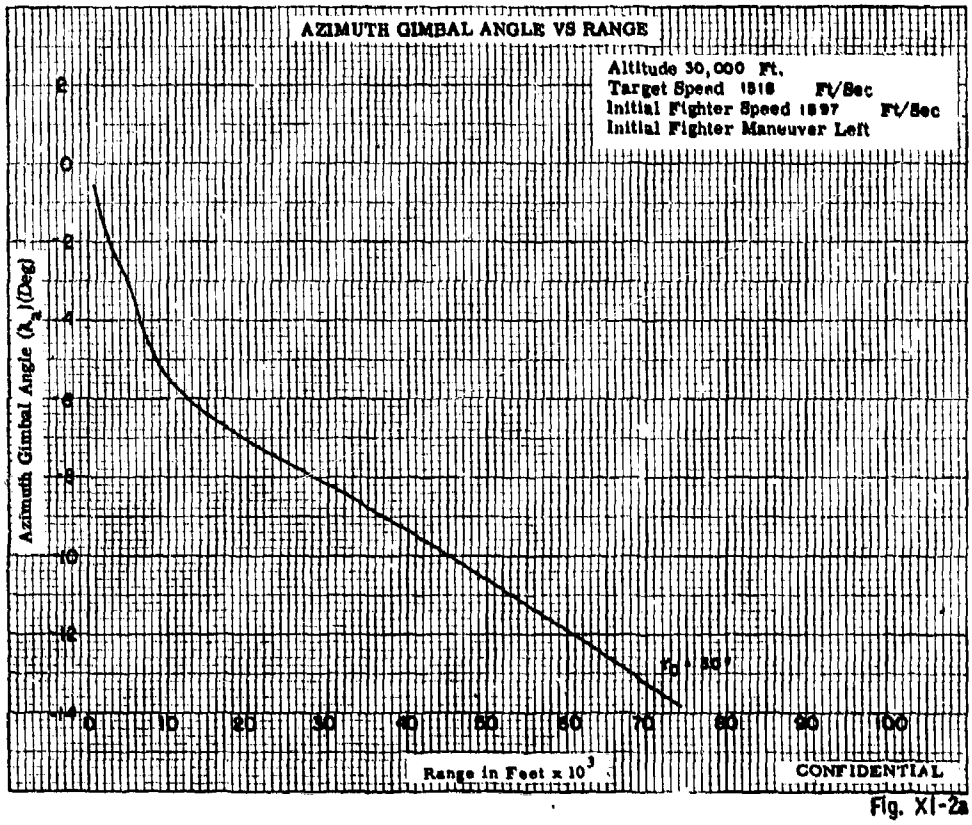
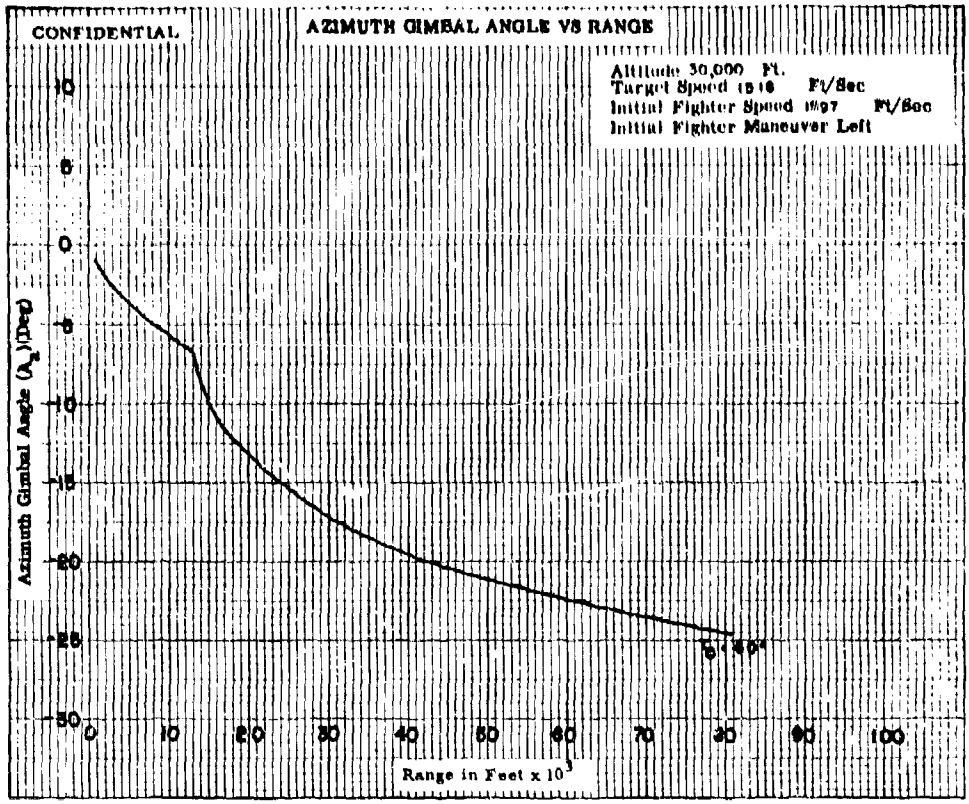

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_z)(Deg)
Range in Feet x 10^3

Fig. XI-2a


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_z)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

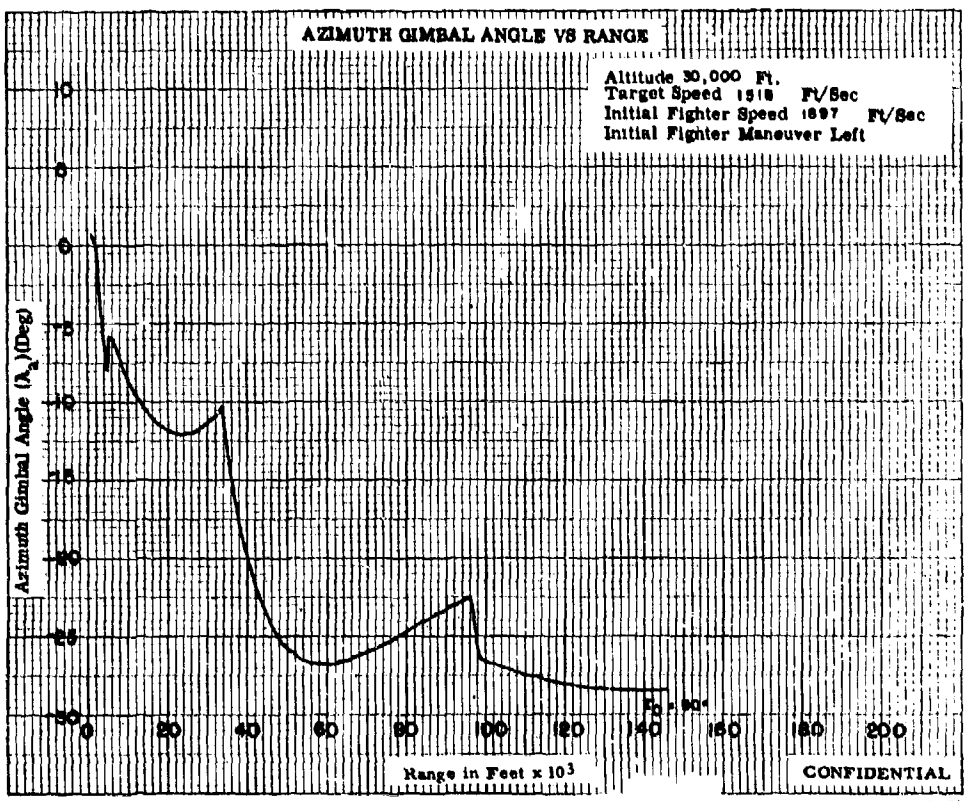
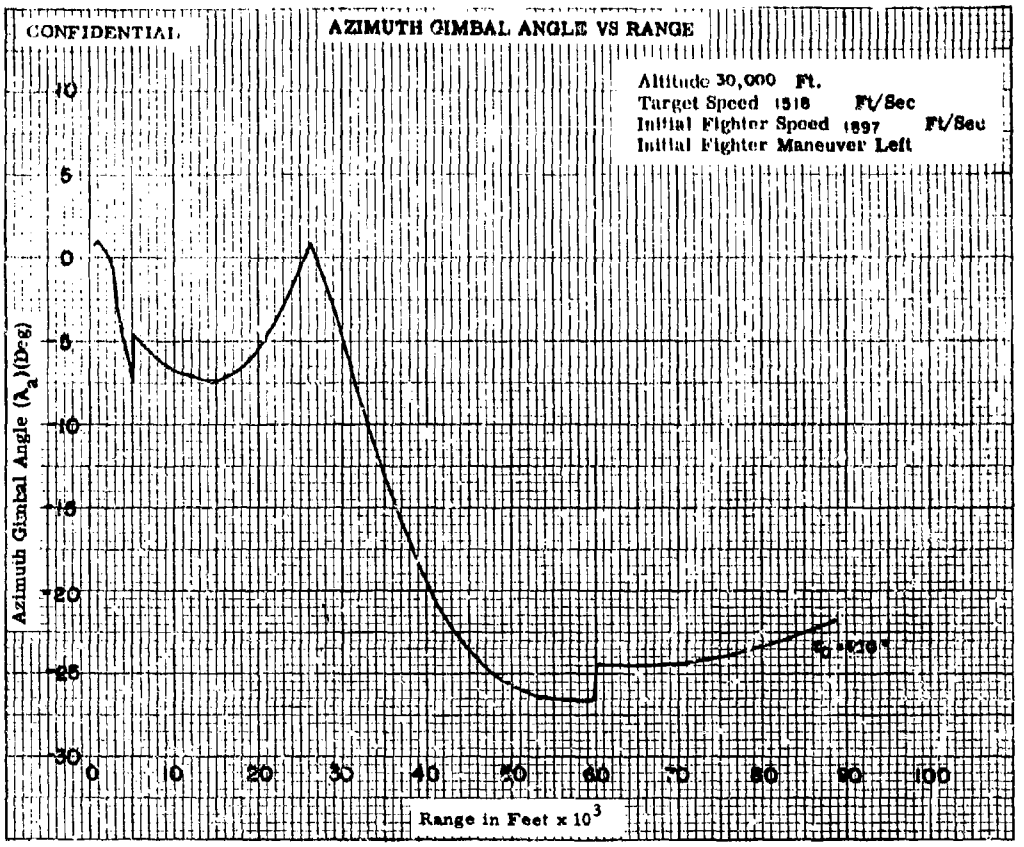

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_z)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-2b


CONFIDENTIAL
AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_z)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
σ_c = 210°

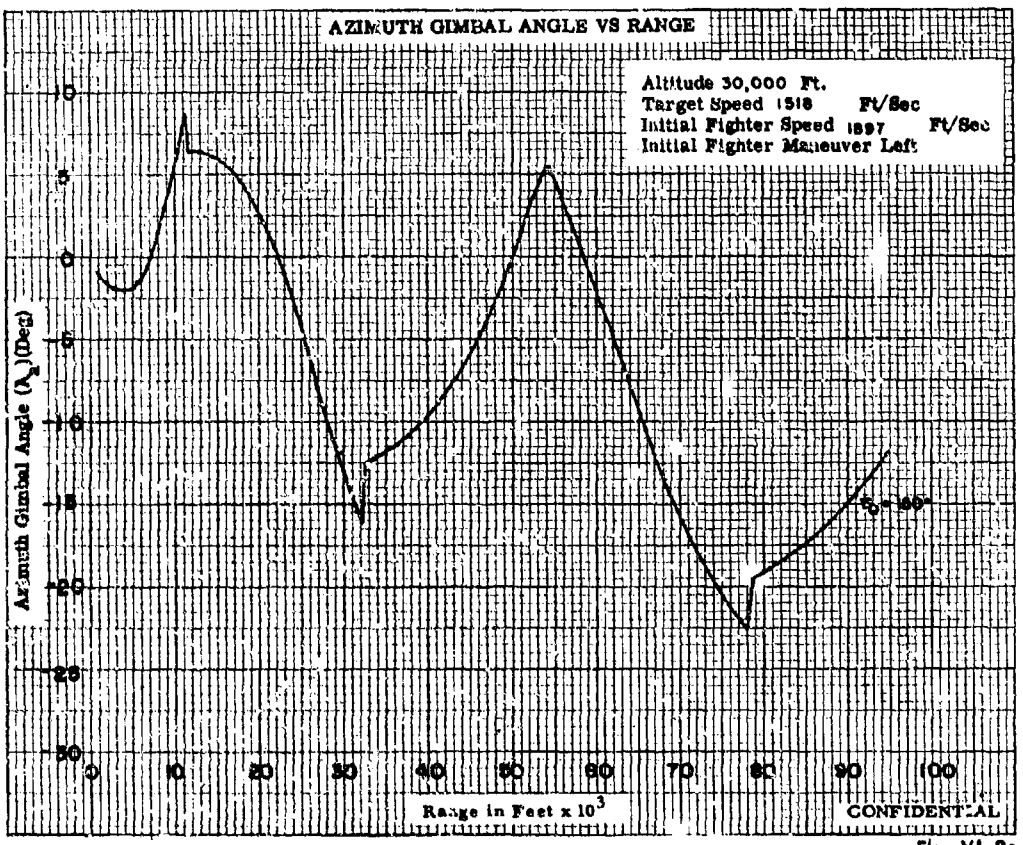
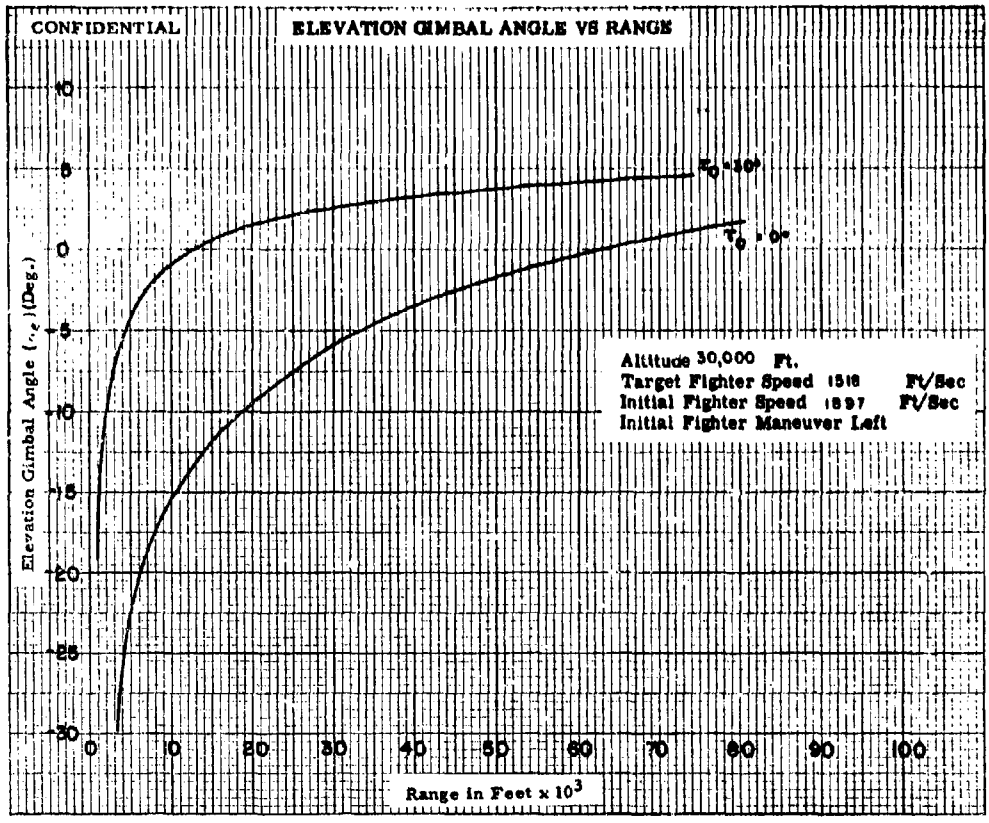

AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Gimbal Angle (A_z)(Deg)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
σ_c = 60°
CONFIDENTIAL

Fig. XI-2c


CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Elevation Gimbal Angle (λ_e)(Deg.)
10
5
0
-5
-10
-15
-20
-25
-30
$\lambda_0 = 10°$
$\lambda_0 = 0°$
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

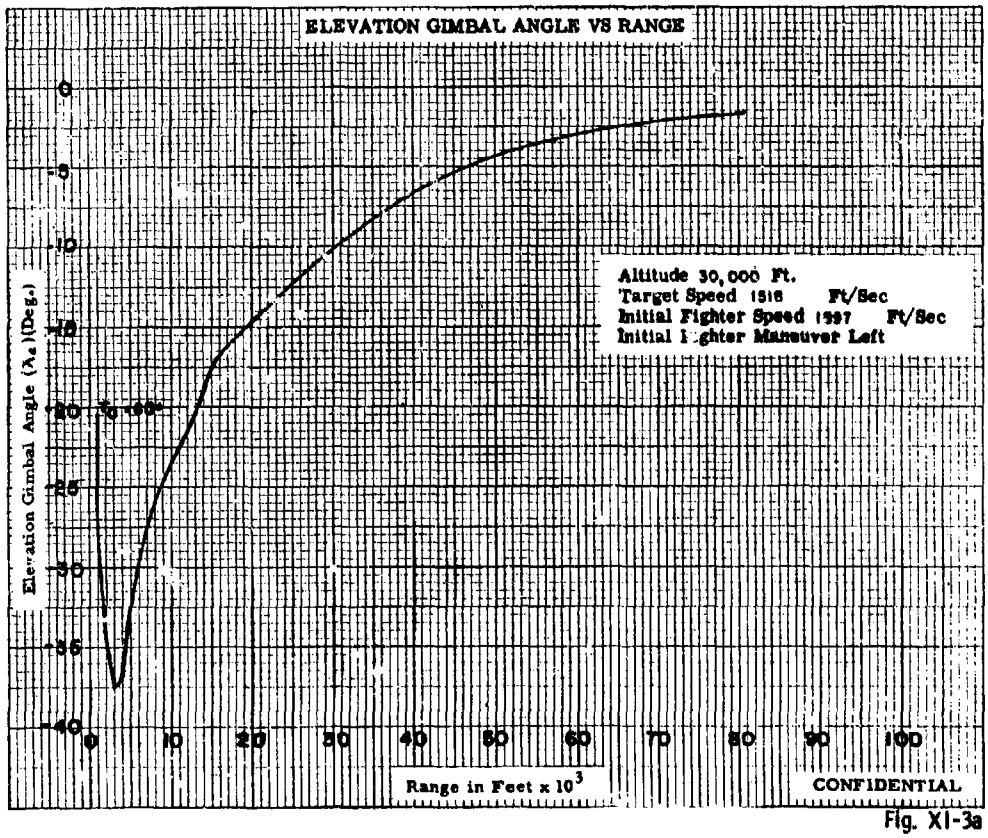
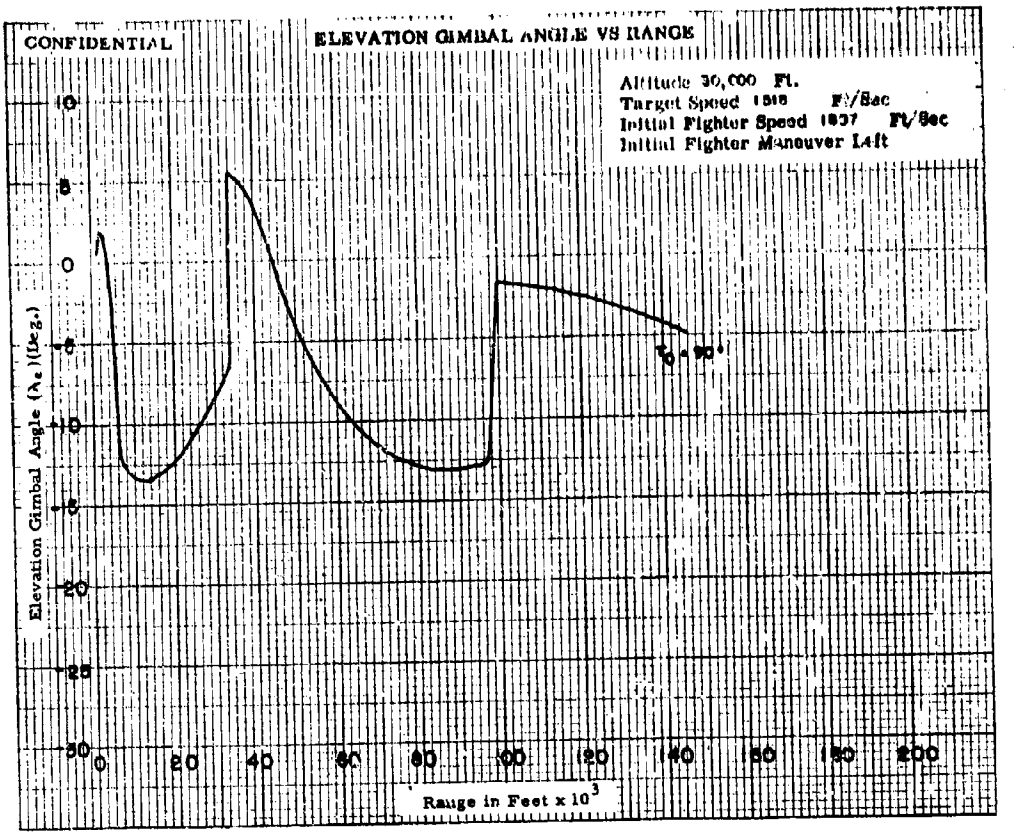

ELEVATION GIMBAL ANGLE VS RANGE
Elevation Gimbal Angle (λ_e)(Deg.)
0
-5
-10
-15
-20
-25
-30
-35
-40
$\lambda_0 = -60°$
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-3a


CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
τ_0 = 90°
Elevation Gimbal Angle (λ_e)(Deg.)
10
5
0
-5
-10
-15
-20
-25
-30
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3

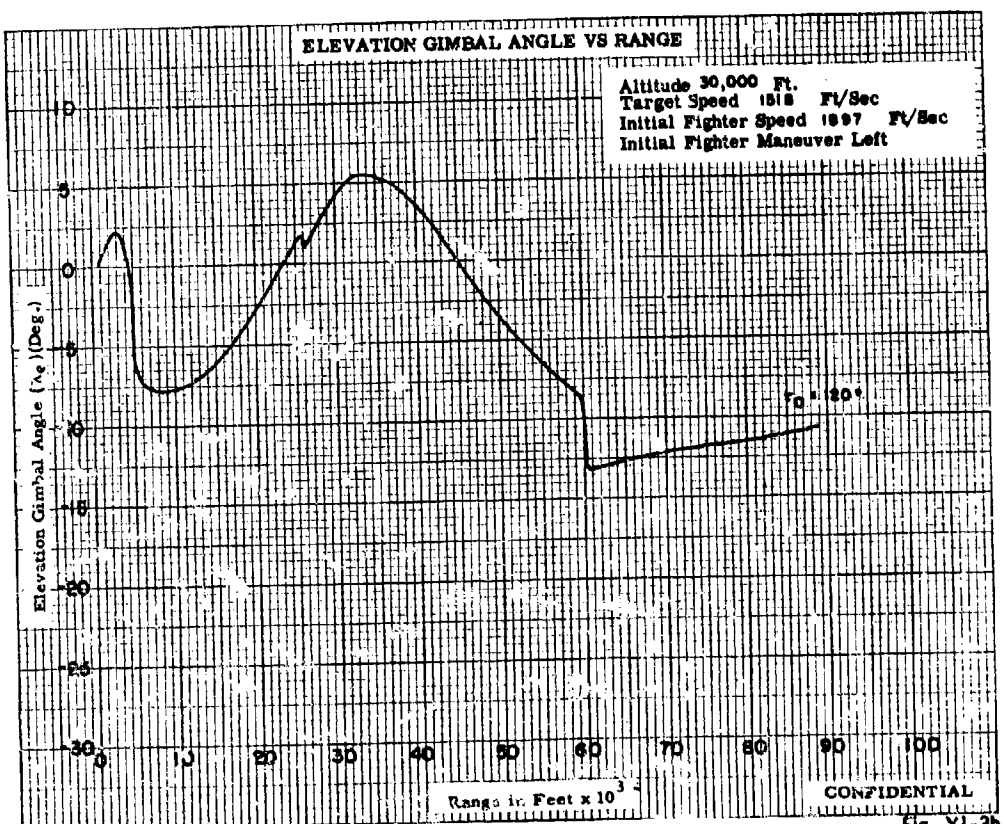

ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
τ_0 = 90°
Elevation Gimbal Angle (λ_e)(Deg.)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-3b

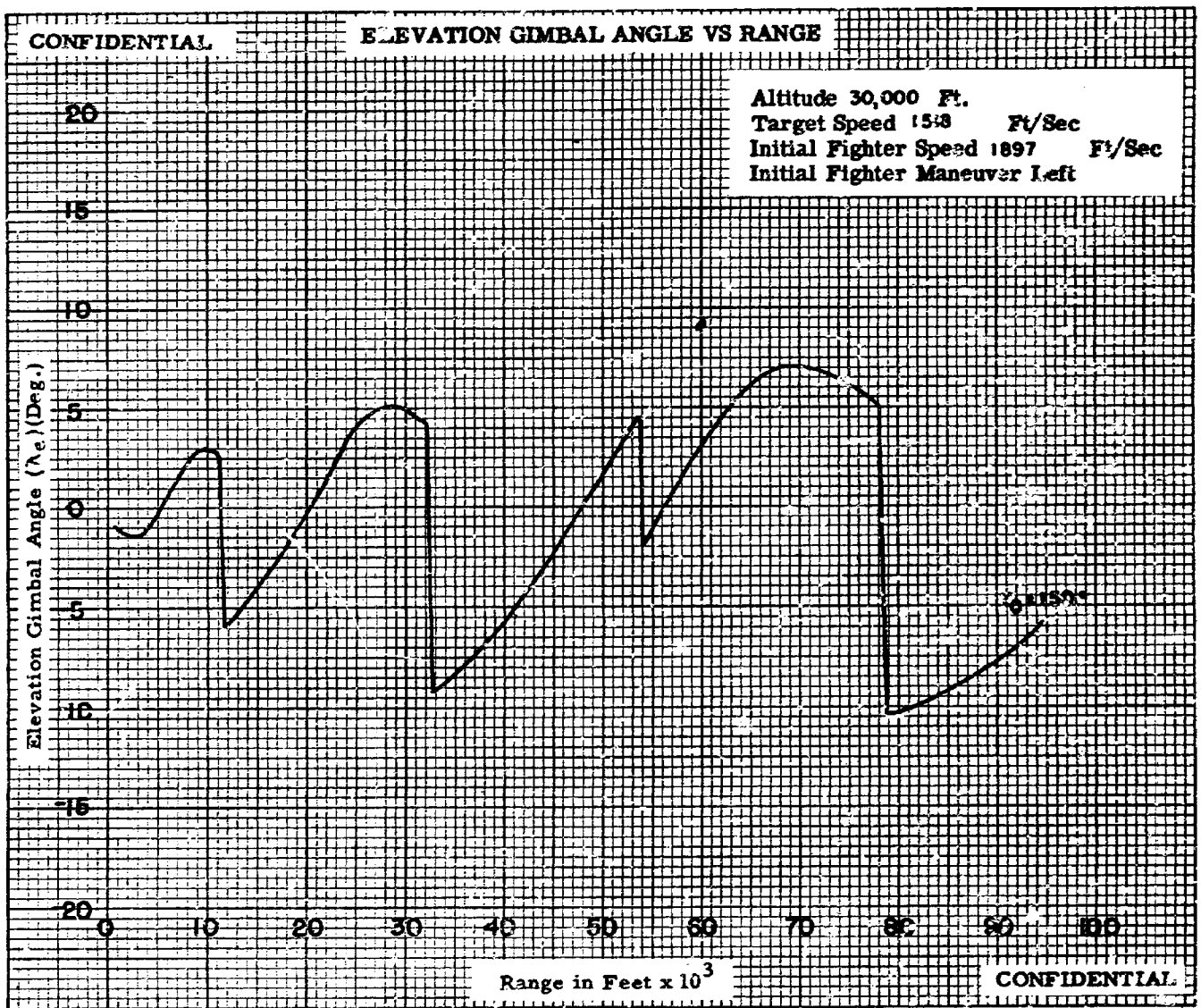
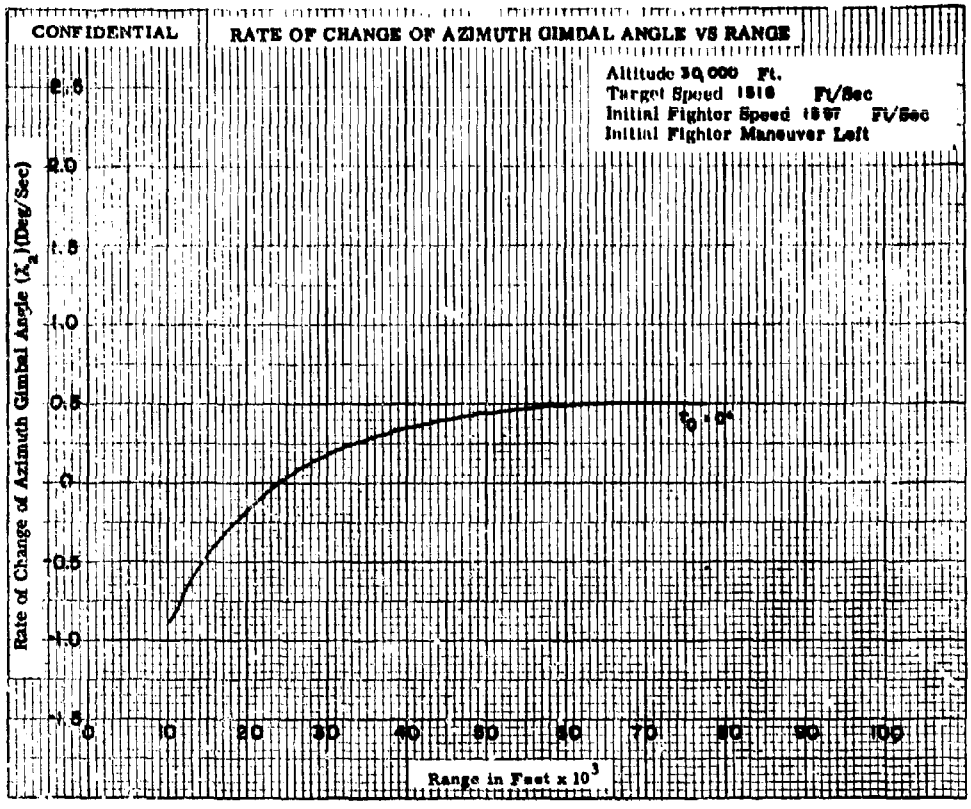
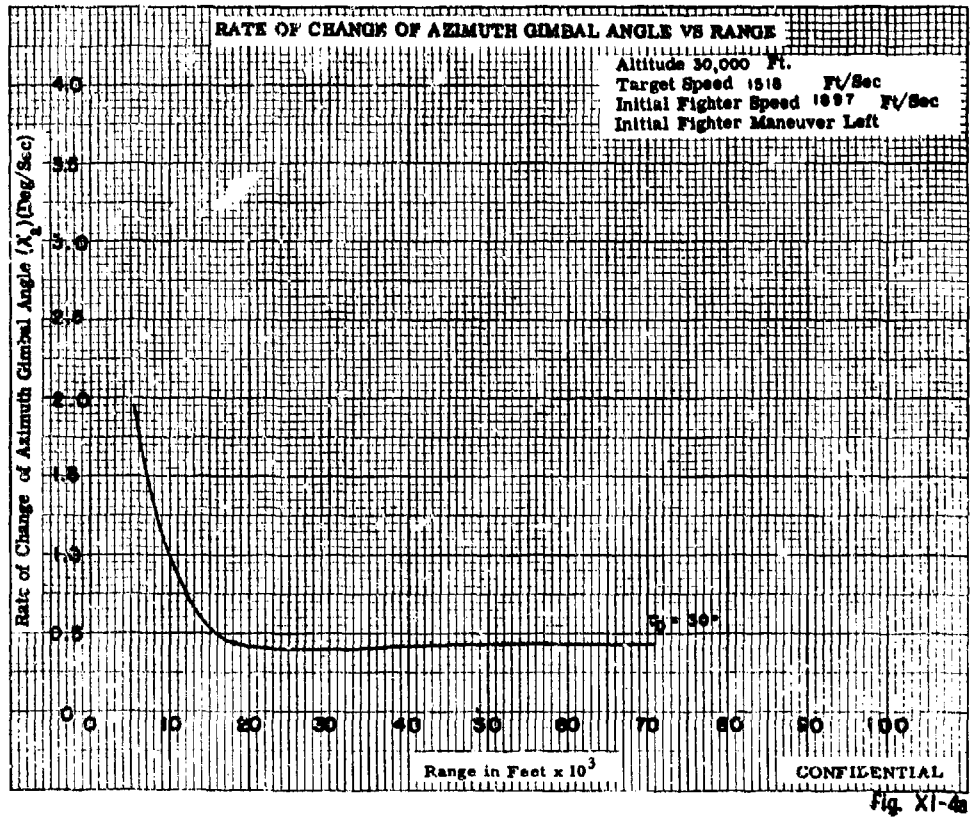

CONFIDENTIAL
ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1538 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Elevation Gimbal Angle (λ_e)(Deg.)
20
15
10
5
0
-5
-10
-15
-20
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-3c

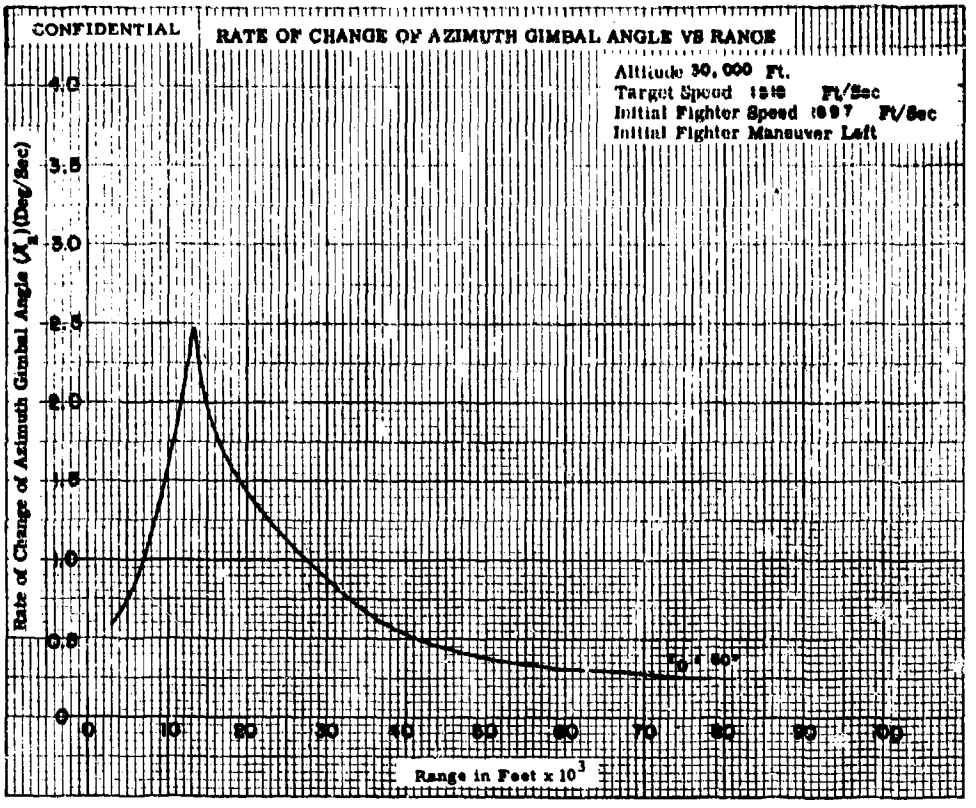
CONFIDENTIAL





CONFIDENTIAL

Fig. XI-4a


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Azimuth Gimbal Angle ($\dot{\chi}_2$)(Deg/Sec)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
10
20
30
40
50
60
70
80
90
100
$\chi_0 = 60°$
Range in Feet x 10^3

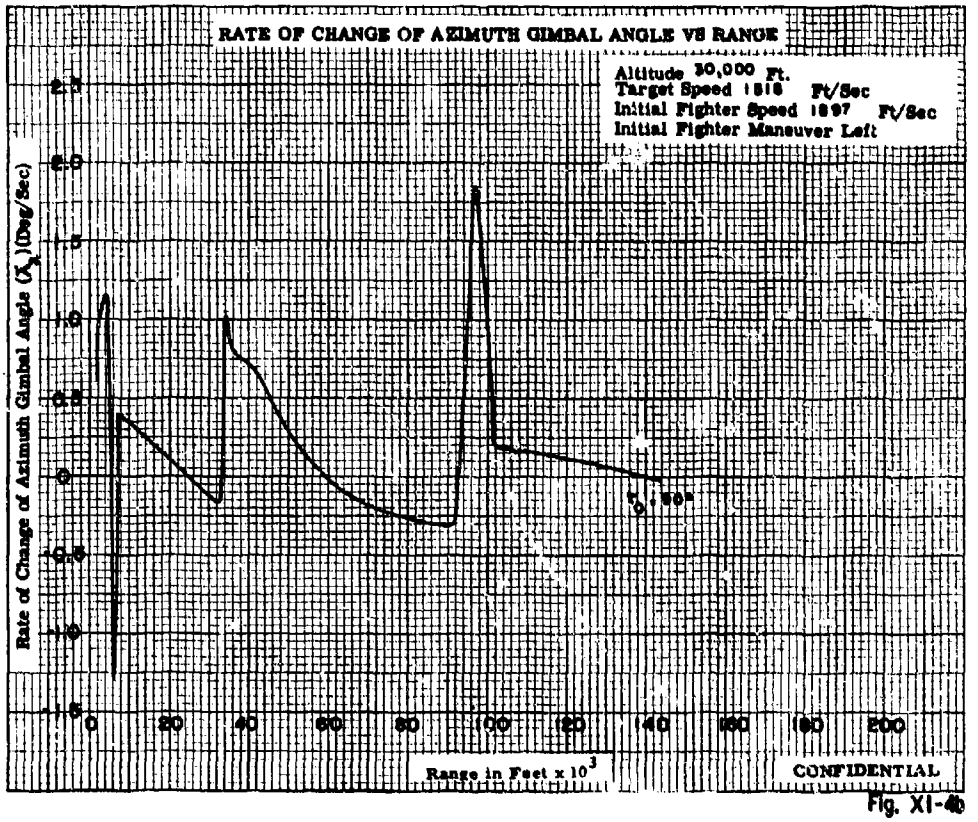
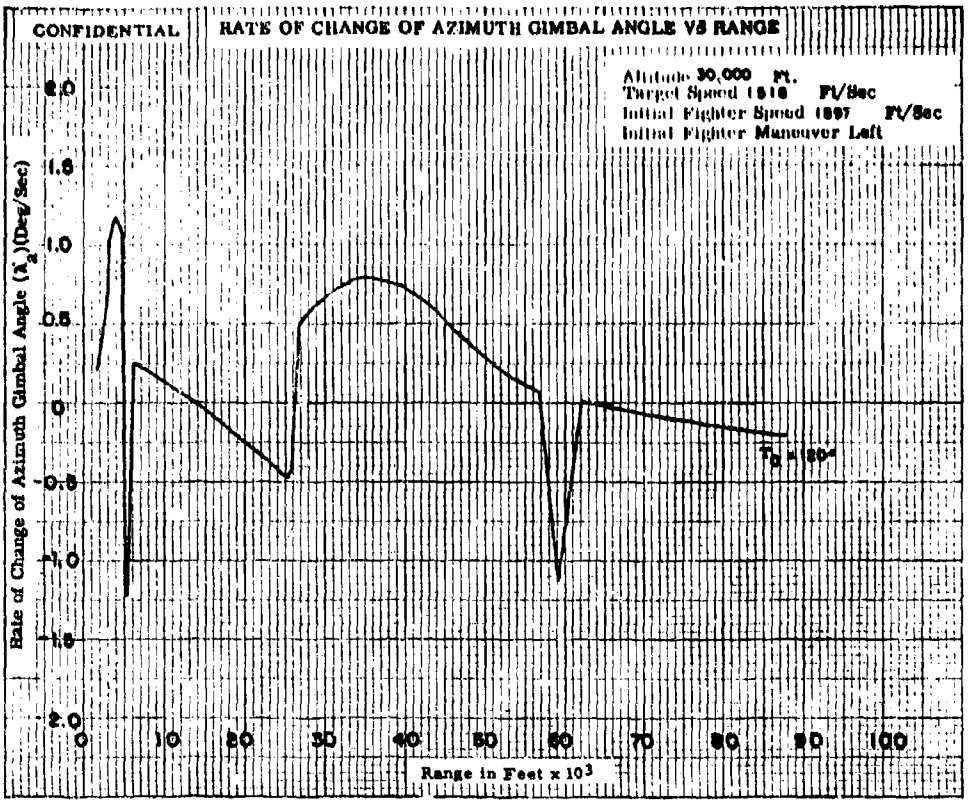

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Azimuth Gimbal Angle ($\dot{\chi}_2$)(Deg/Sec)
2.5
2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
0
20
40
60
80
100
120
140
160
180
200
$\chi_0 = 60°$
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-40


CONFIDENTIAL
RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
ψ_0 = 180°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

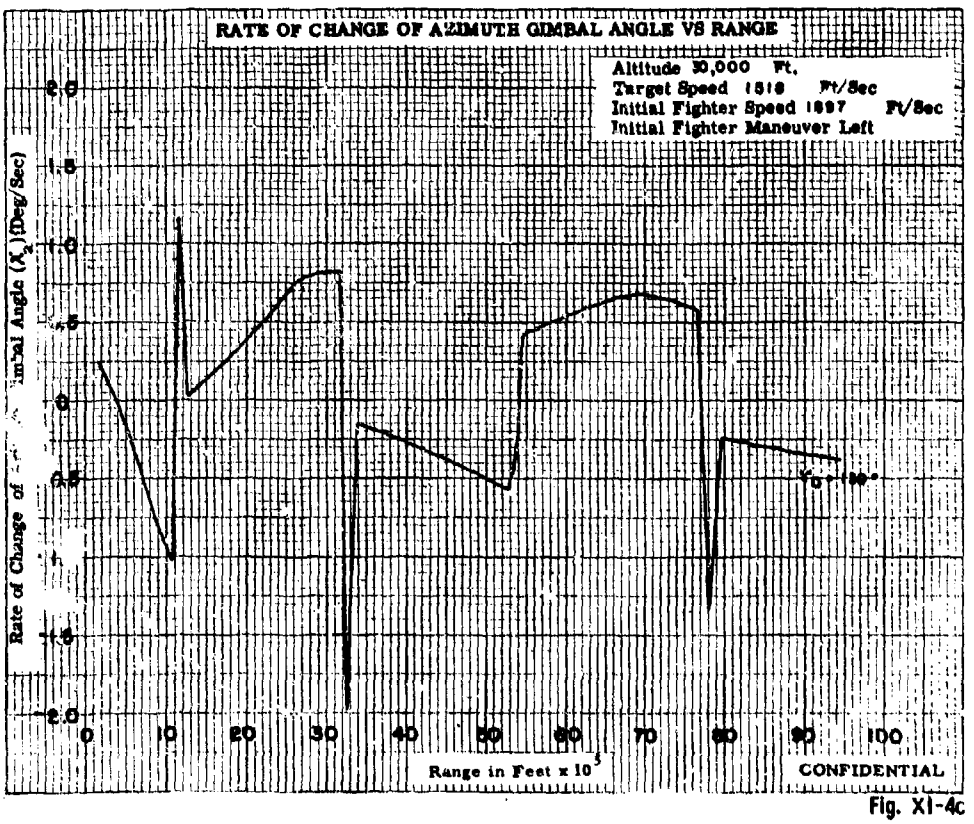
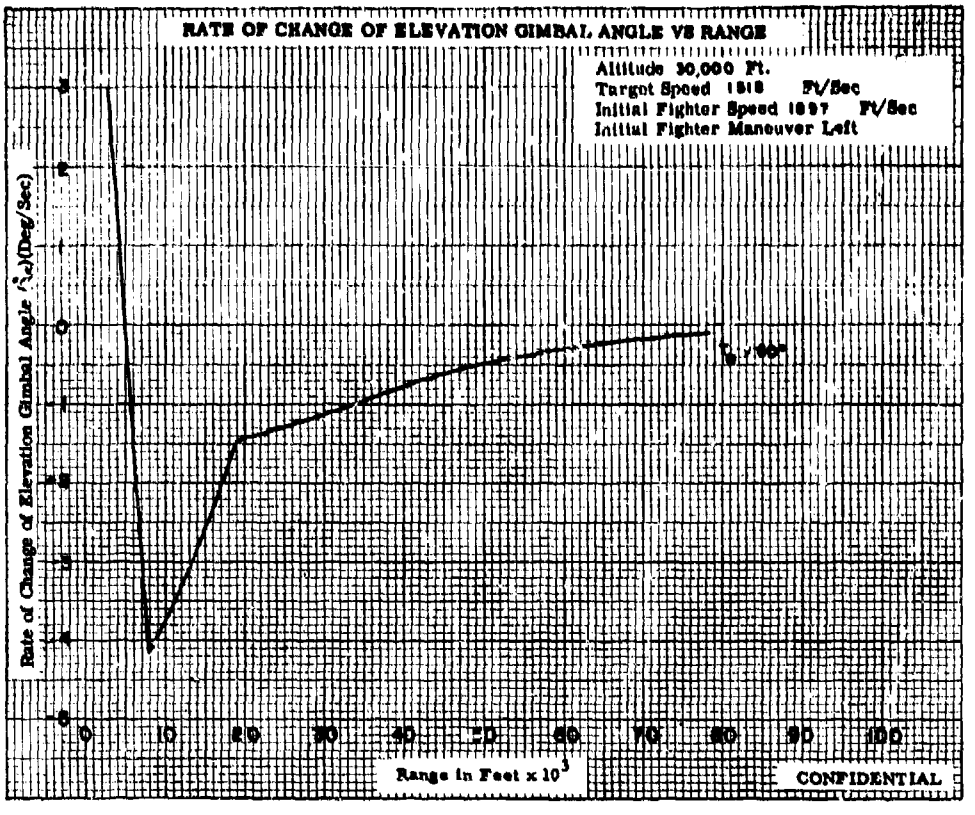

RATE OF CHANGE OF AZIMUTH GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Azimuth Gimbal Angle ($\dot{\lambda}_2$)(Deg/Sec)
2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
ψ_0 = 180°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-4c


RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Elevation Gimbal Angle (θ̇e)(Deg/Sec)
Range in Feet x 10^3
CONFIDENTIAL

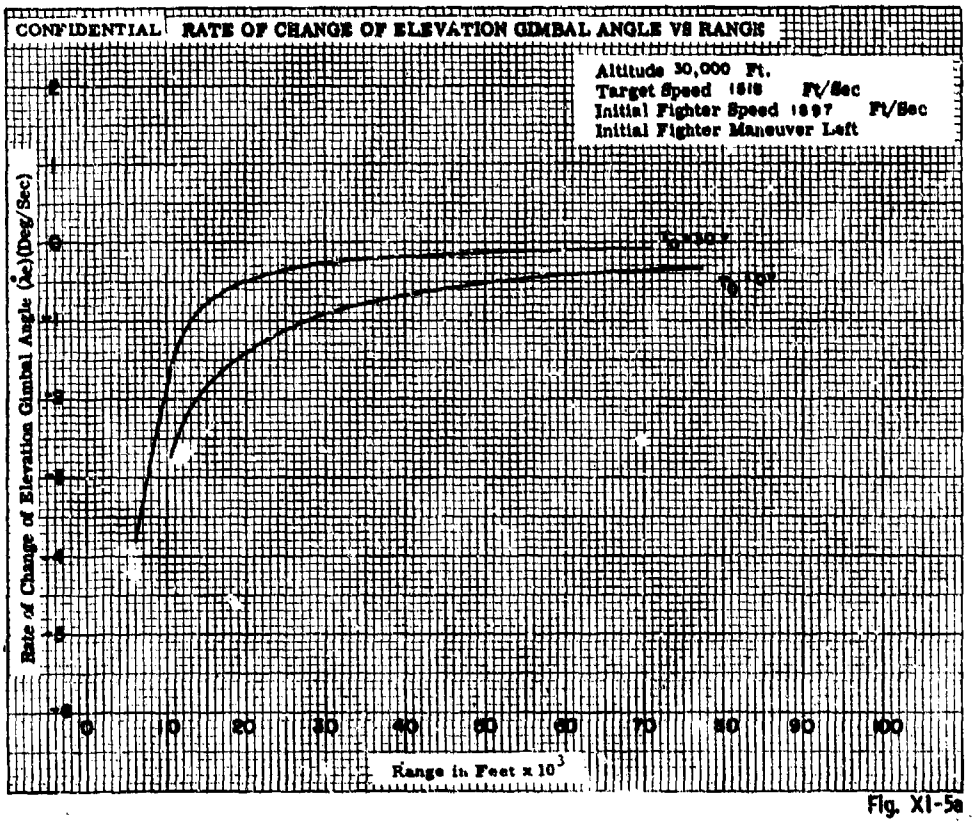

CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Elevation Gimbal Angle (θ̇e)(Deg/Sec)
Range in Feet x 10^3

Fig. XI-5a

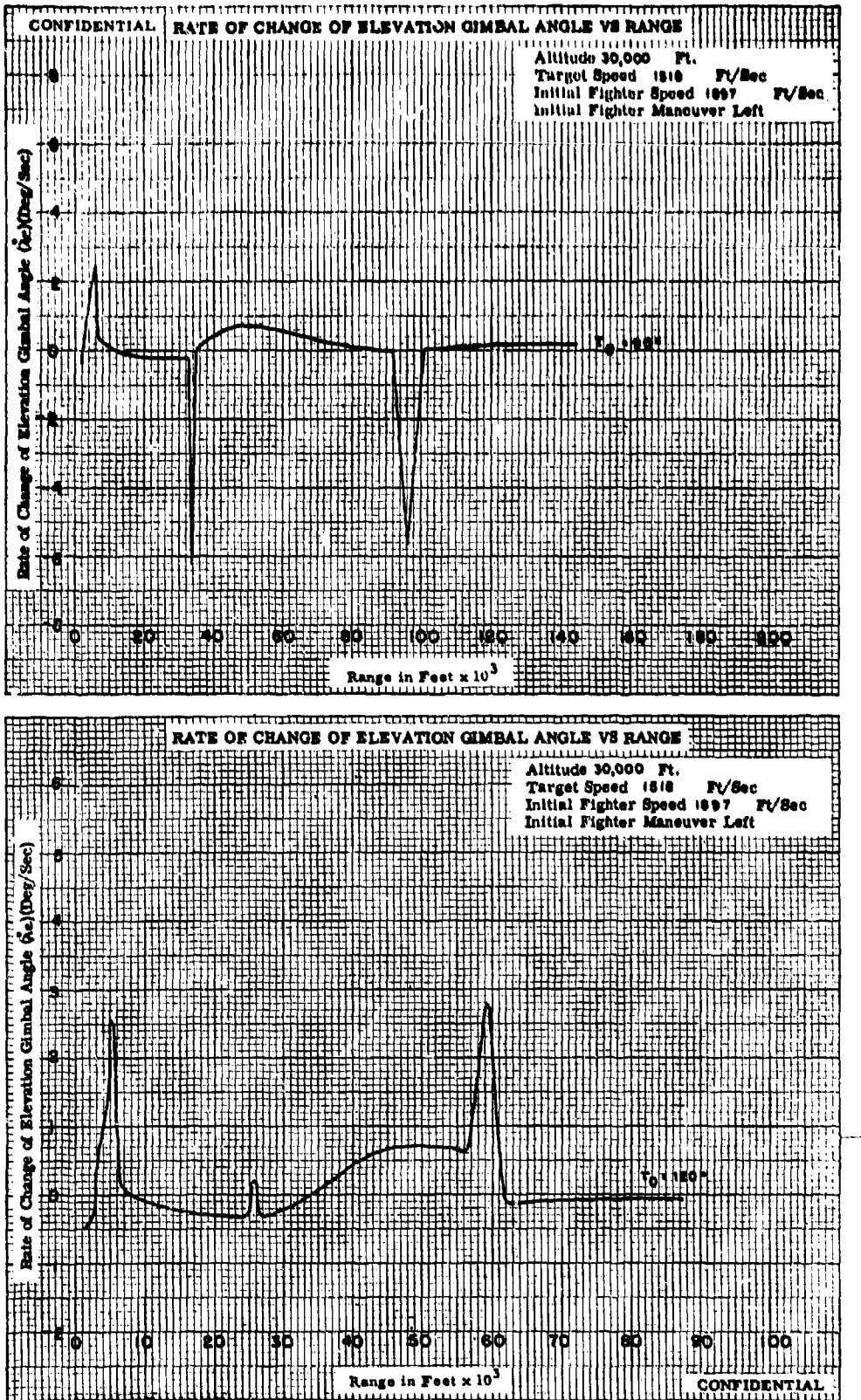

CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 1097 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Elevation Gimbal Angle (θ̇e)(Deg/Sec)
Range in Feet x 10^3
0
20
40
60
80
100
120
140
160
180
200
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1818 Ft/Sec
Initial Fighter Speed 1097 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Elevation Gimbal Angle (θ̇e)(Deg/Sec)
Range in Feet x 10^3
0
10
20
30
40
50
60
70
80
90
100
CONFIDENTIAL

Fig. XI-5b

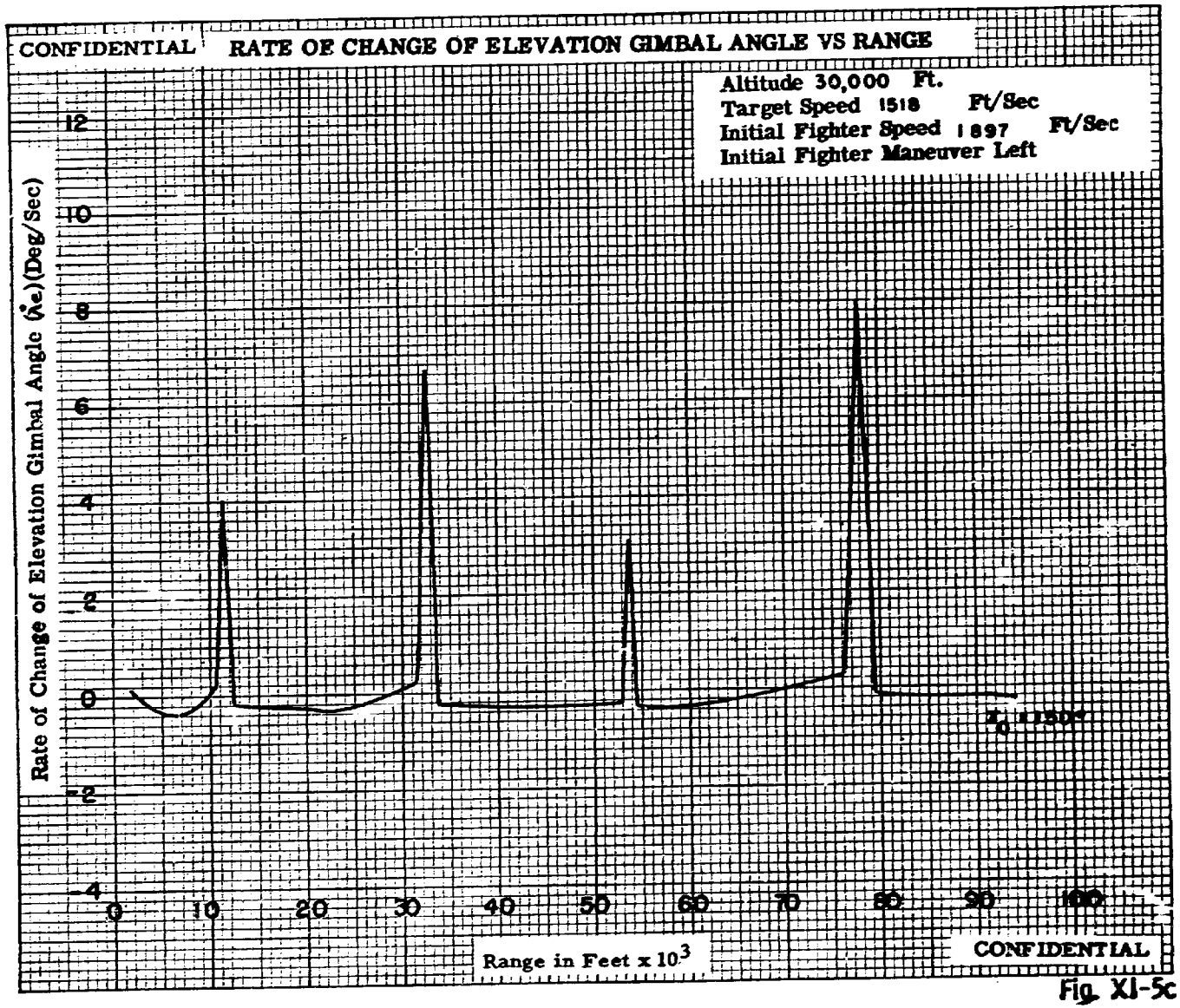
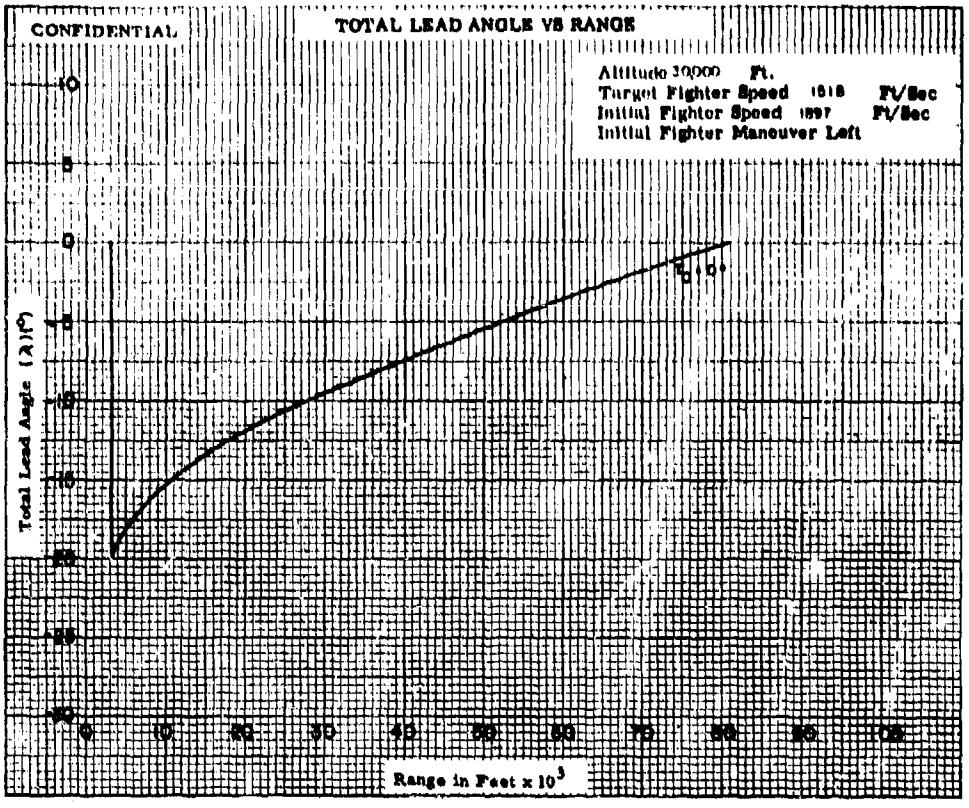

CONFIDENTIAL
RATE OF CHANGE OF ELEVATION GIMBAL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Rate of Change of Elevation Gimbal Angle (λ̇e)(Deg/Sec)
12
10
8
6
4
2
0
-2
-4
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10³
CONFIDENTIAL

Fig. XI-5c


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 30000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Total Lead Angle (λ)(°)
Range in Feet x 10³

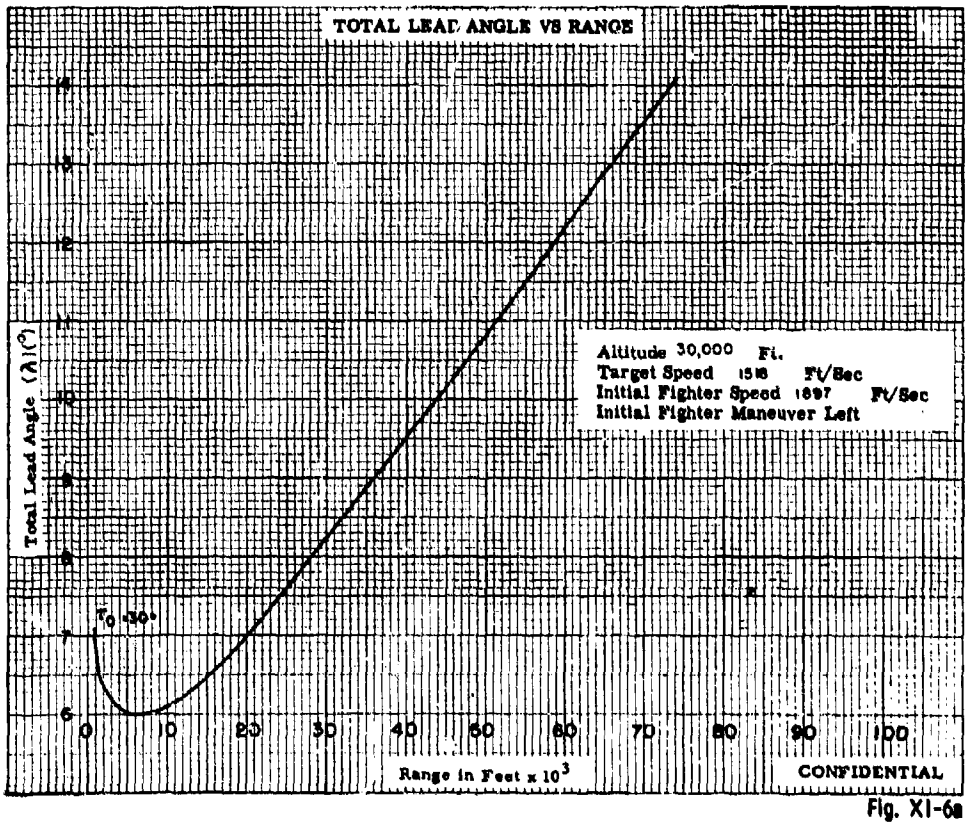
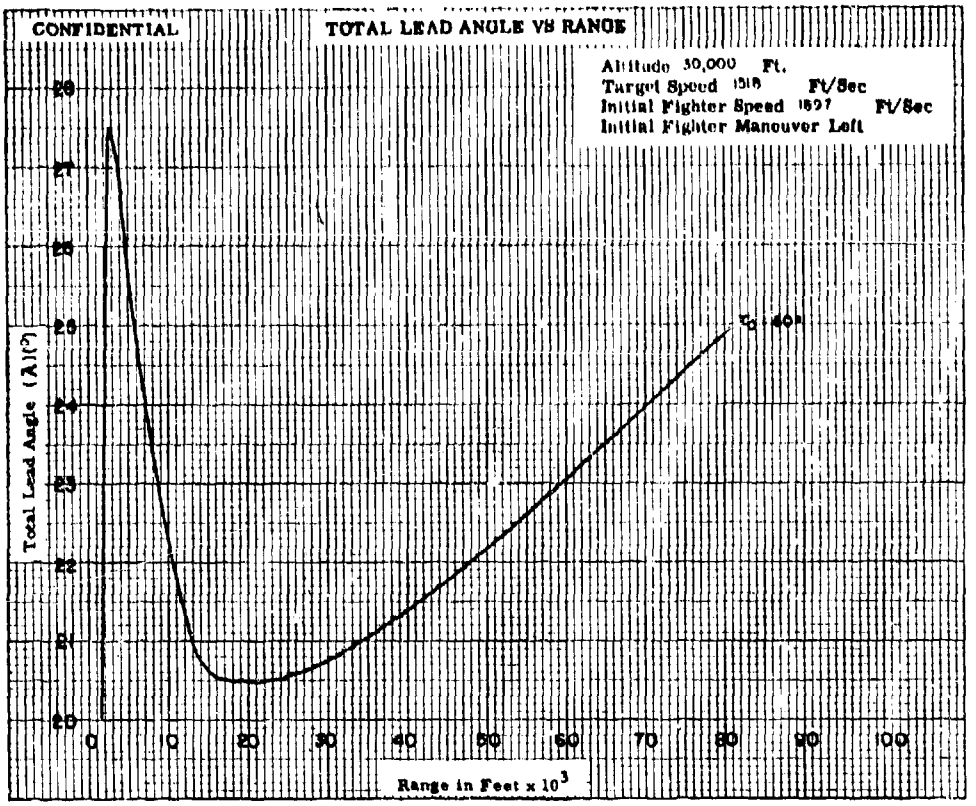

TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Total Lead Angle (λ)(°)
Range in Feet x 10³
CONFIDENTIAL

Fig. XI-6a


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Total Lead Angle (λ)(°)
Range in Feet x 10³

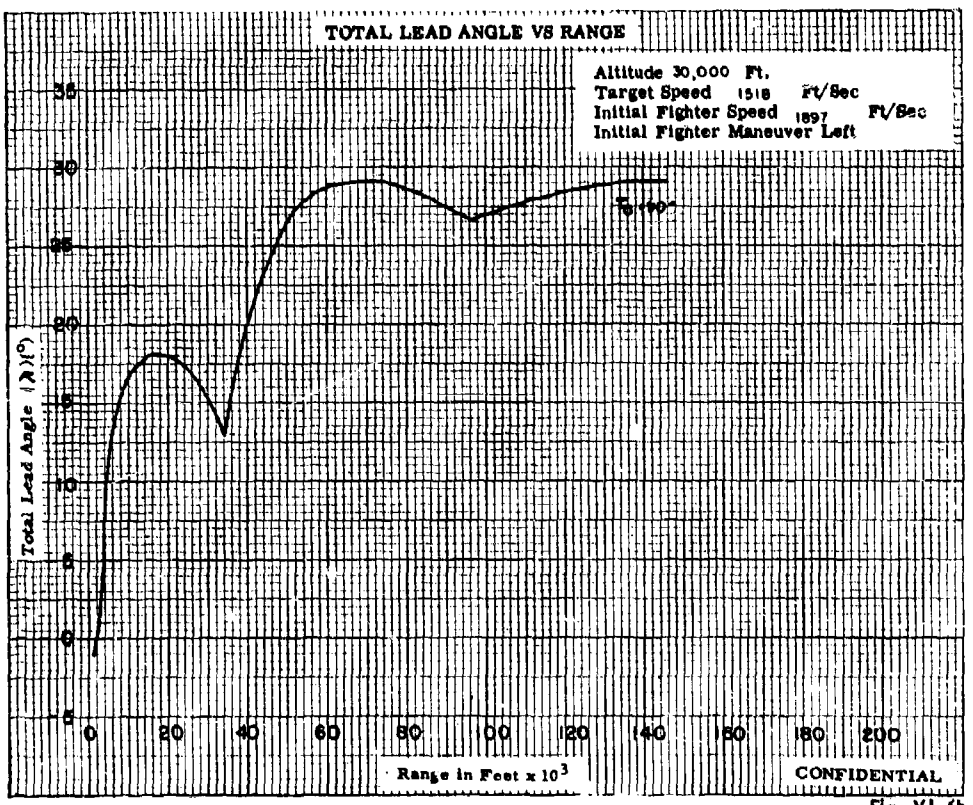
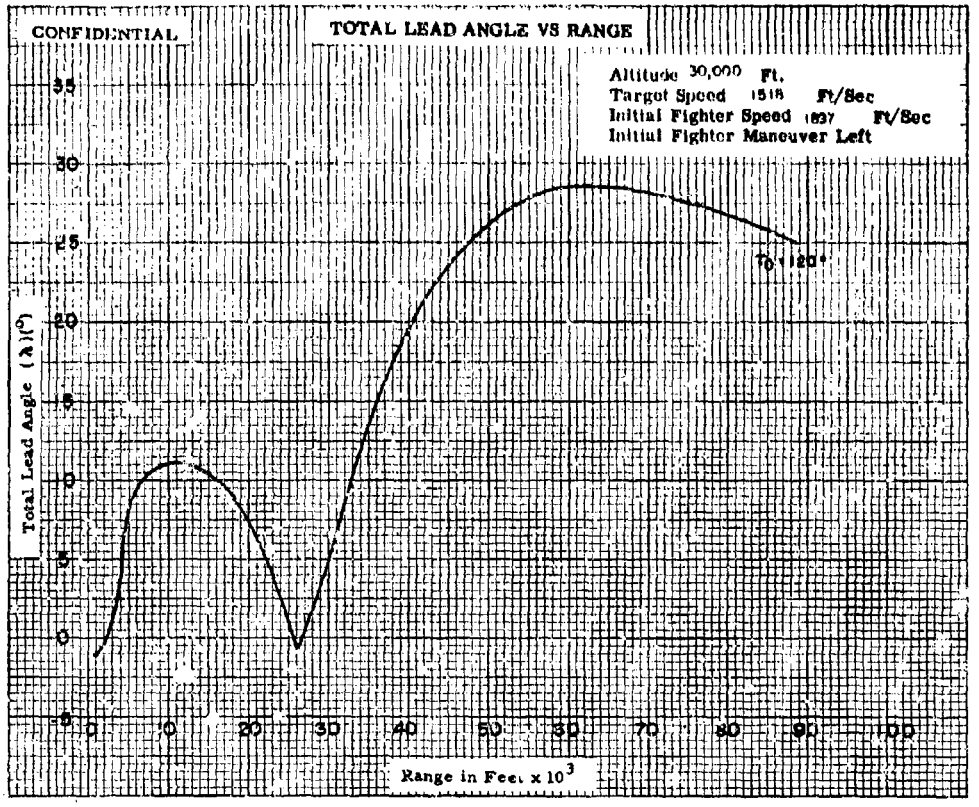

TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Total Lead Angle (λ)(°)
Range in Feet x 10³
CONFIDENTIAL

Fig. XI-6b


CONFIDENTIAL
TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
θ_0 120°
Total Lead Angle (λ)(°)
35
30
25
20
15
10
5
0
-5
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

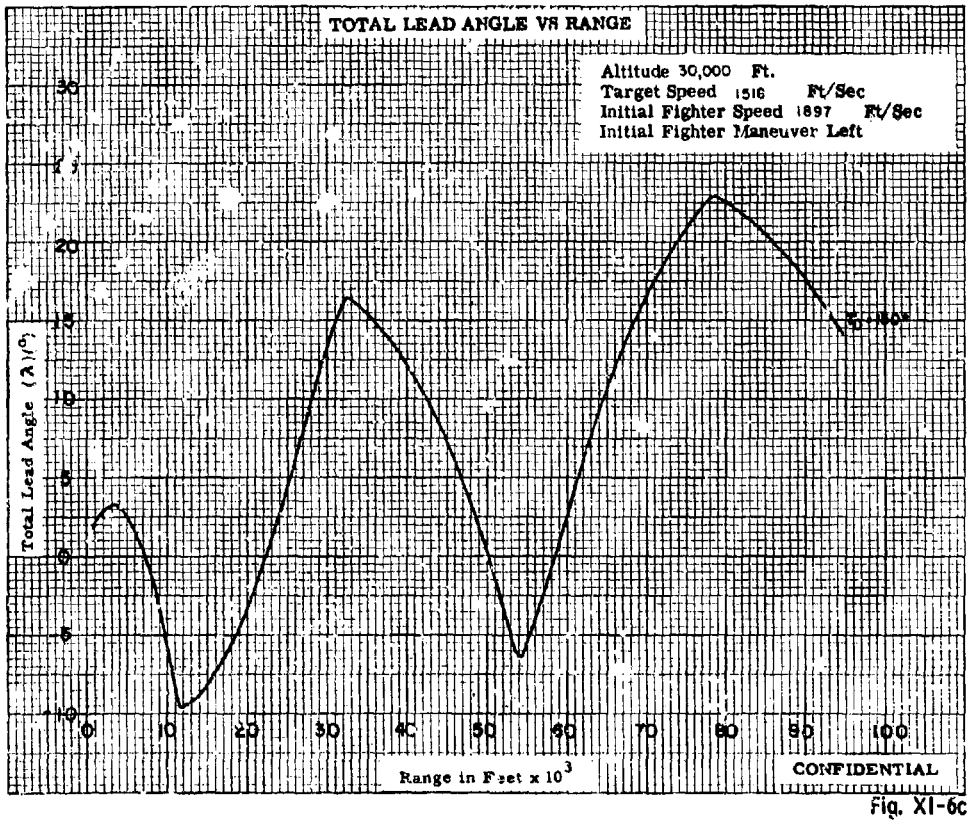
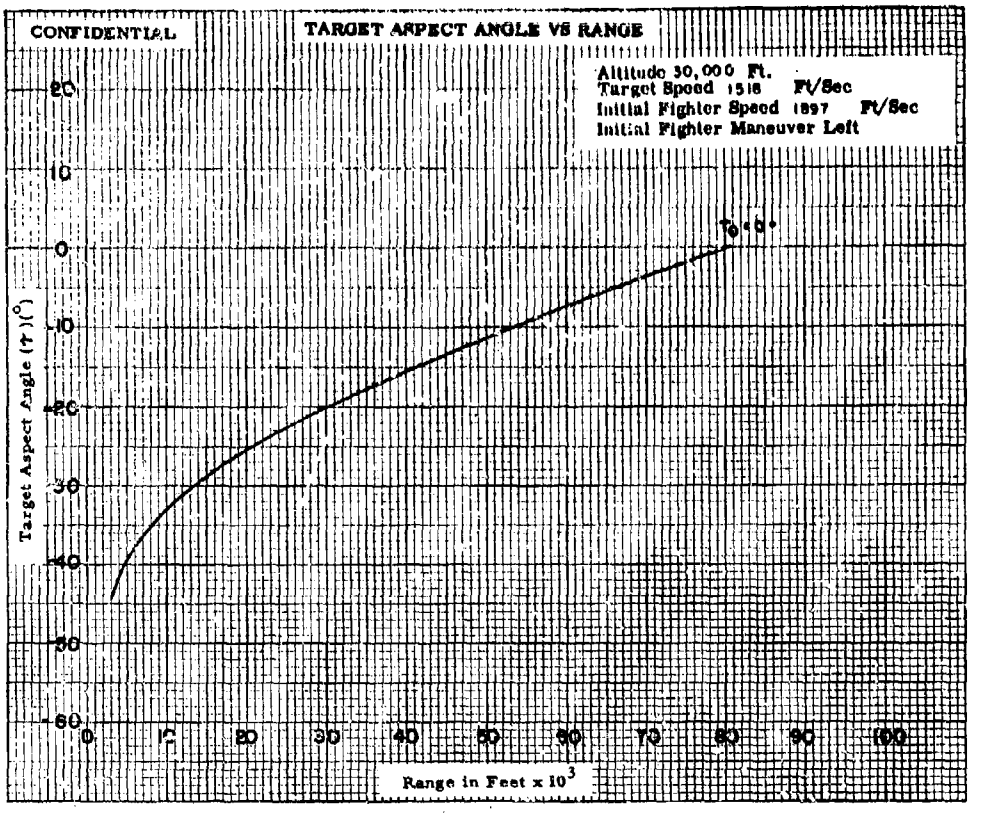

TOTAL LEAD ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1516 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
θ_0 180°
Total Lead Angle (λ)(°)
30
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-6c


CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
$T_0 = 0°$
Target Aspect Angle (ψ)(°)
20
10
0
-10
-20
-30
-40
-50
-60
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

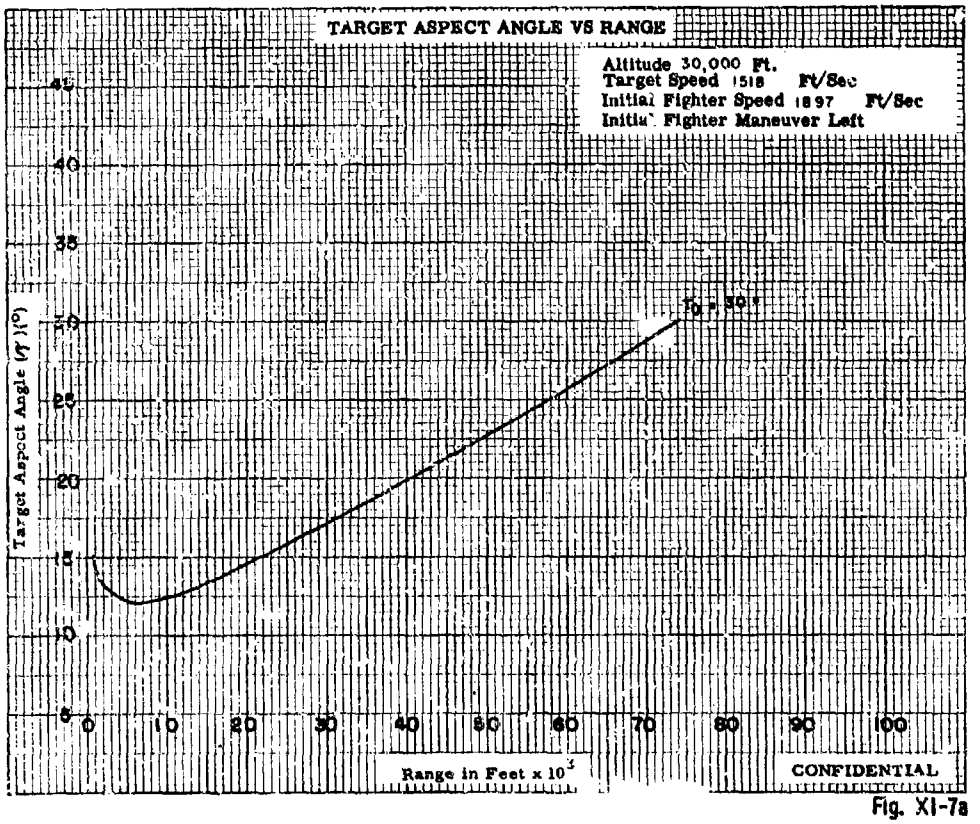
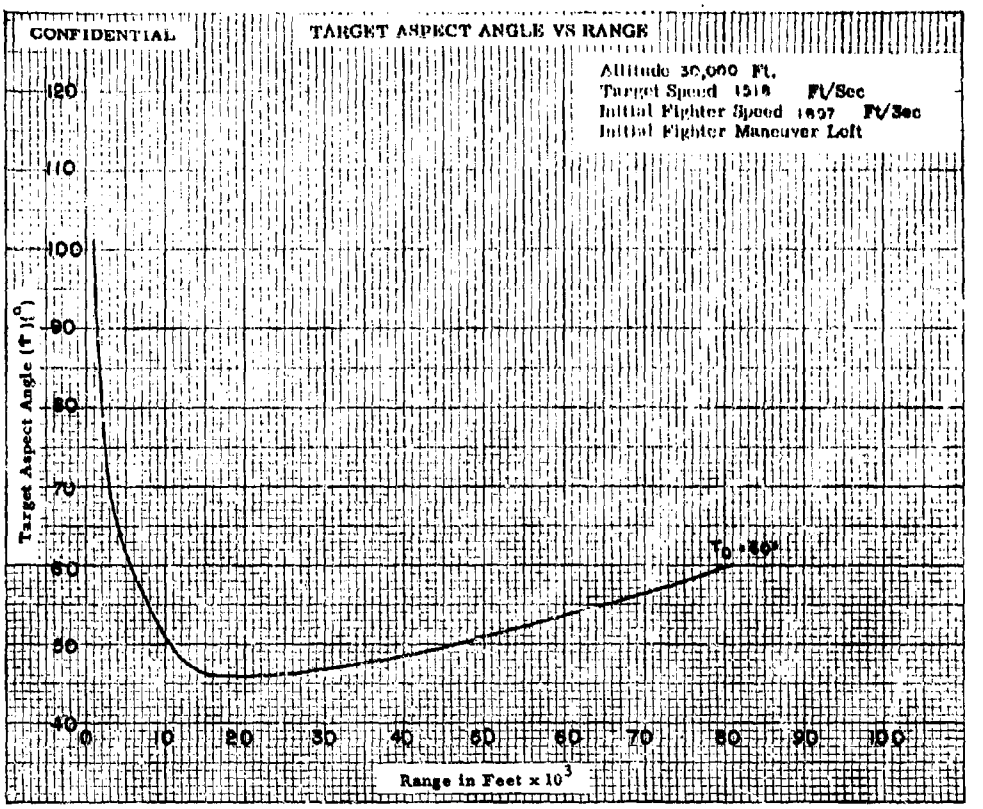

TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
$T_0 = 30°$
Target Aspect Angle (ψ)(°)
45
40
35
30
25
20
15
10
5
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-7a


CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Target Aspect Angle (Ψ)(°)
120
110
100
90
80
70
60
50
40
T_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

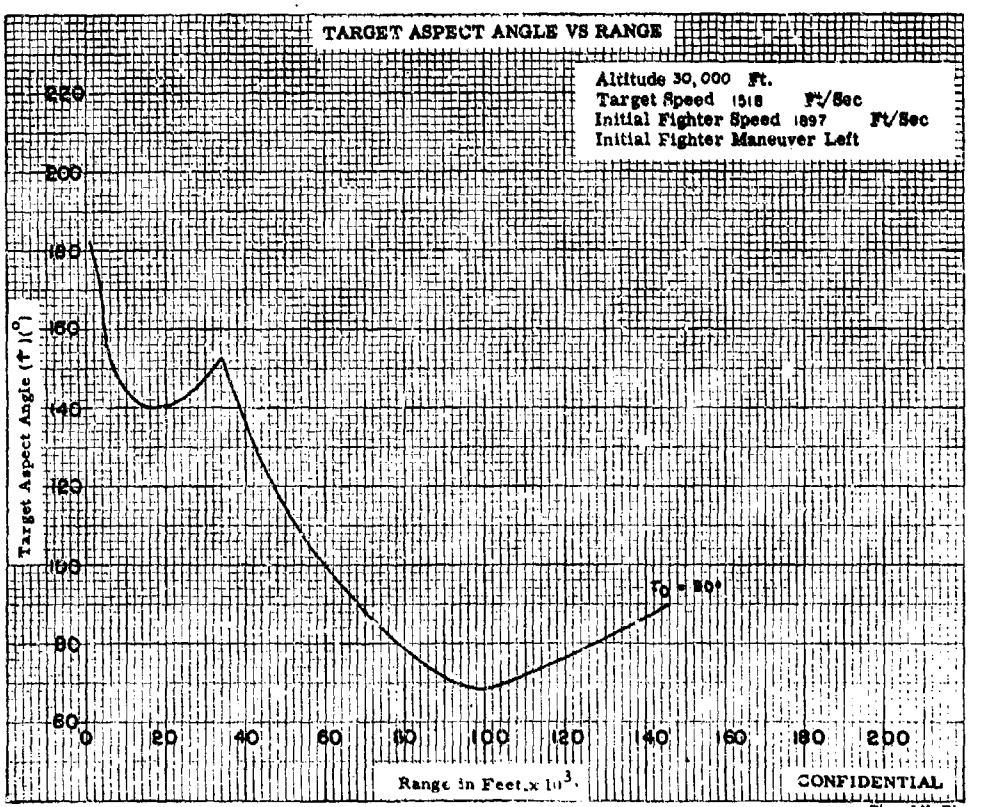
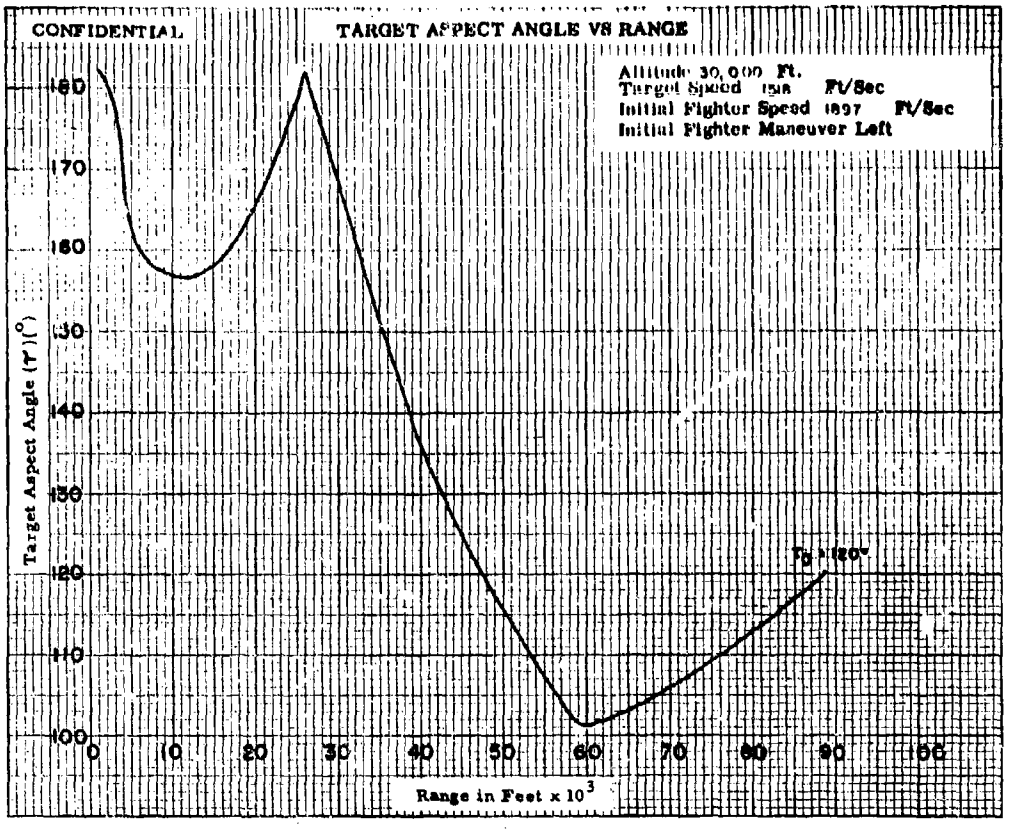

TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Target Aspect Angle (Ψ)(°)
220
200
180
160
140
120
100
80
60
T_0 = 60°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-7b


CONFIDENTIAL
TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Target Aspect Angle (Ψ)(°)
180
170
160
150
140
130
120
110
100
Ψ_0 = 120°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

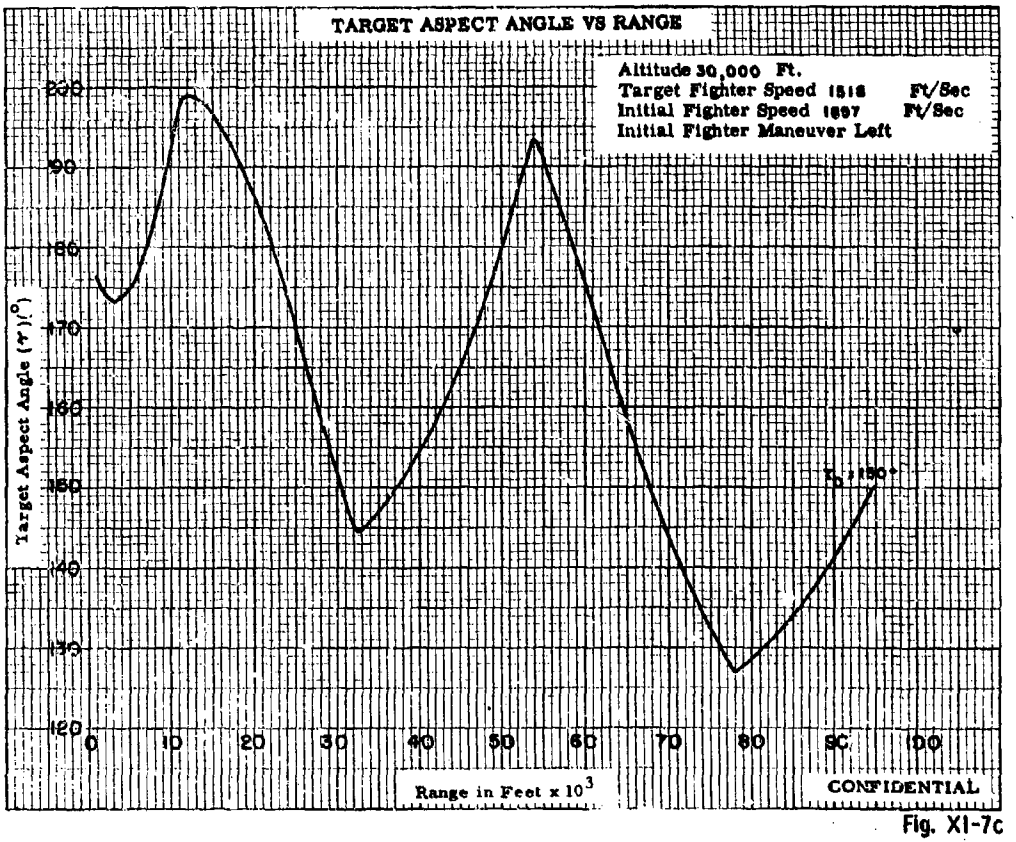
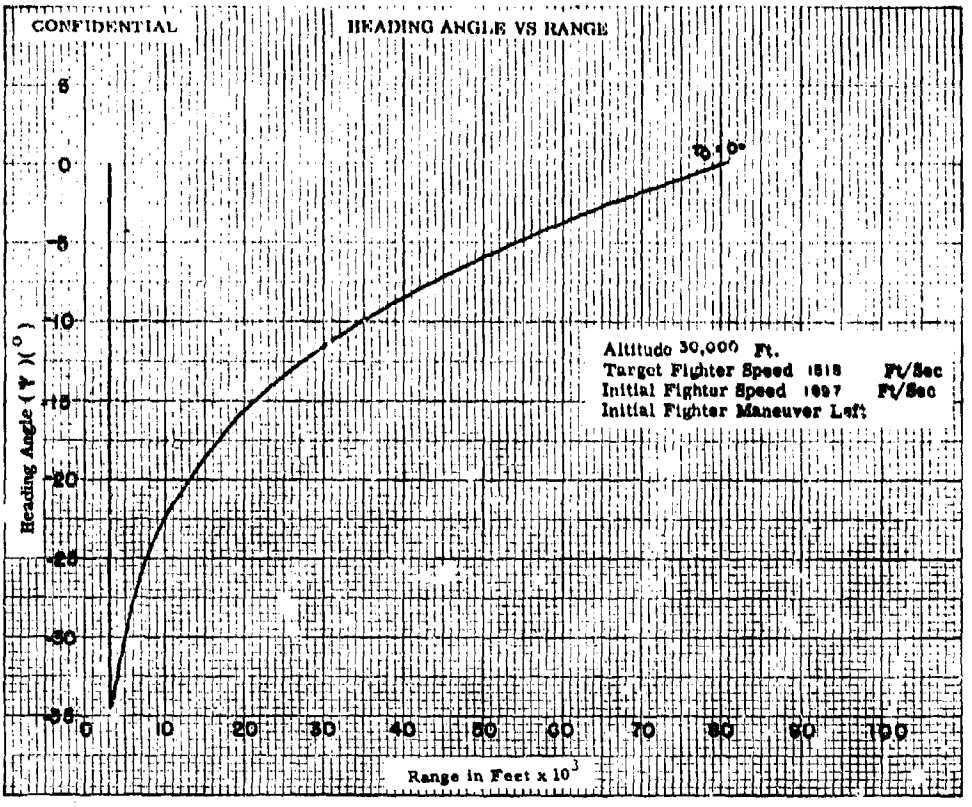

TARGET ASPECT ANGLE VS RANGE
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Target Aspect Angle (Ψ)(°)
200
190
180
170
160
150
140
130
120
Ψ_0 = 150°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-7c


CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
$\psi_0 = 0°$
Heading Angle (Ψ)(^{0})
Range in Feet x 10^3

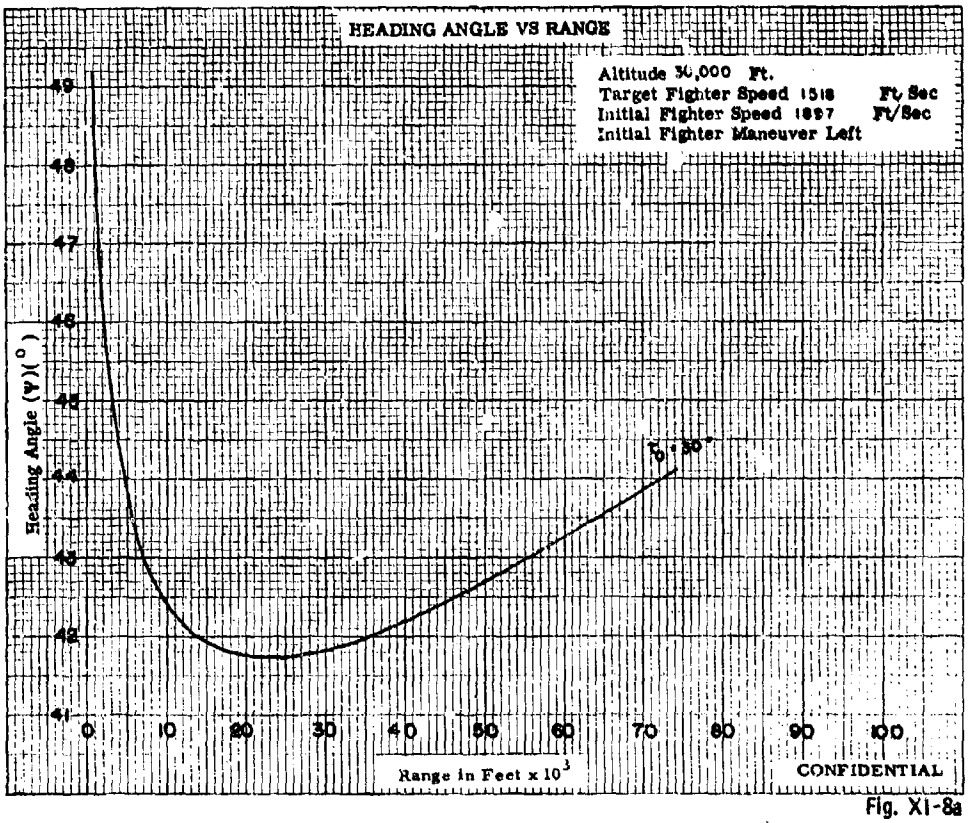
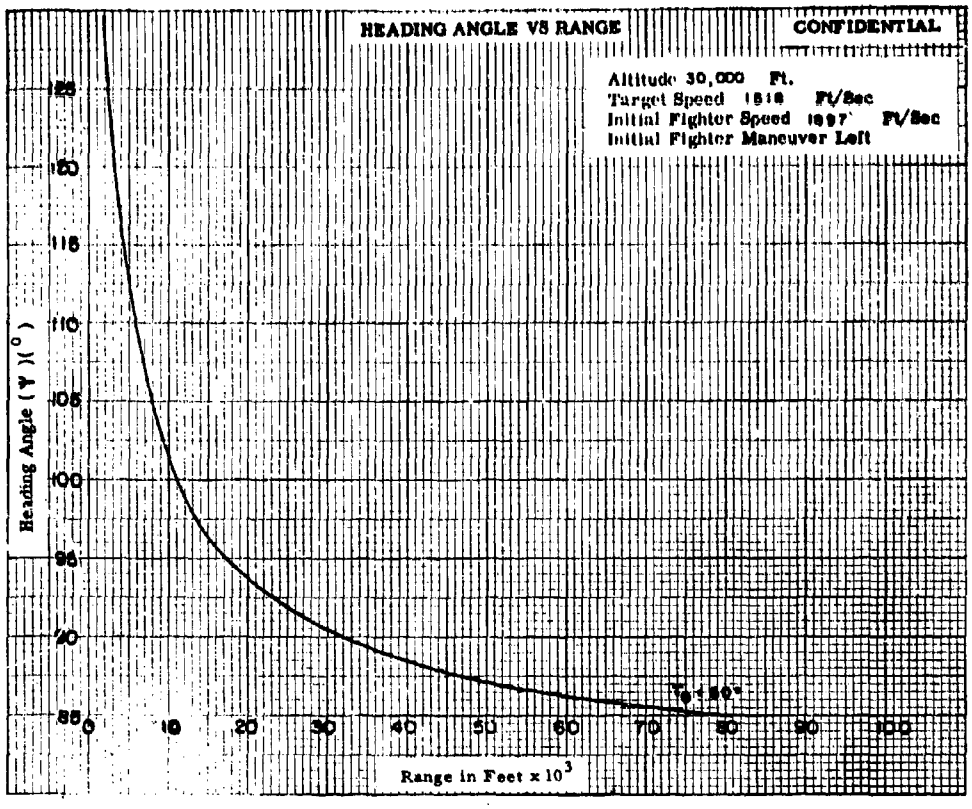

HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
$\psi_0 = 30°$
Heading Angle (Ψ)(^{0})
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-8a


HEADING ANGLE VS RANGE
CONFIDENTIAL
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Heading Angle (Ψ)(°)
125
120
115
110
105
100
95
90
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

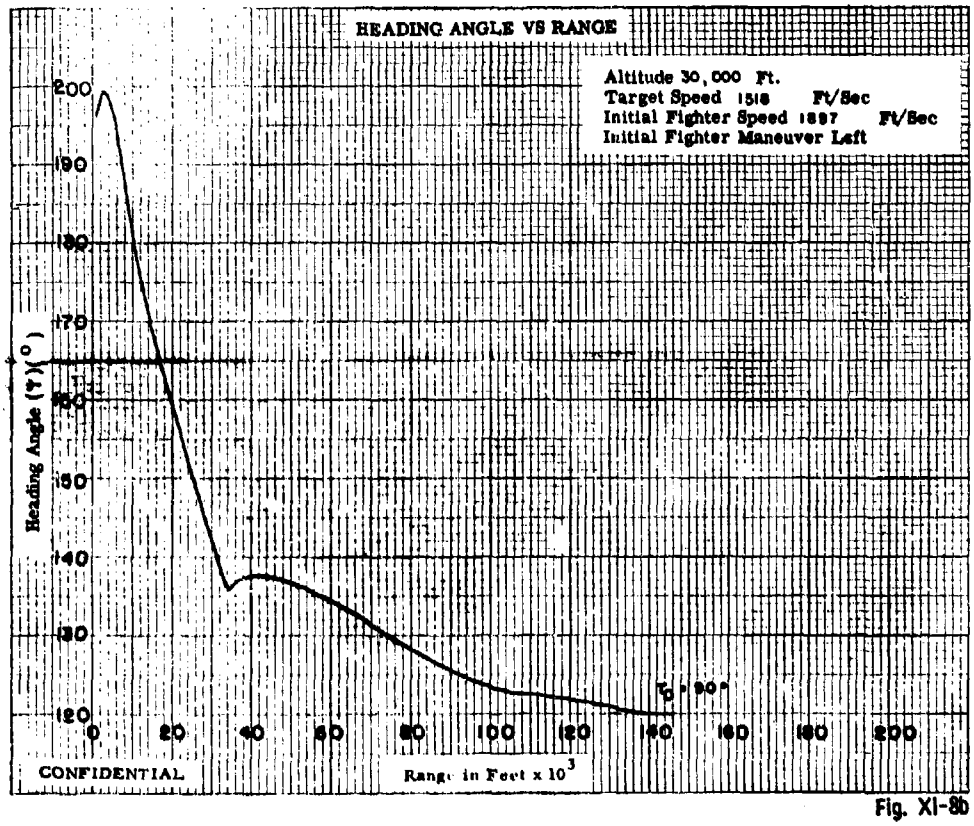
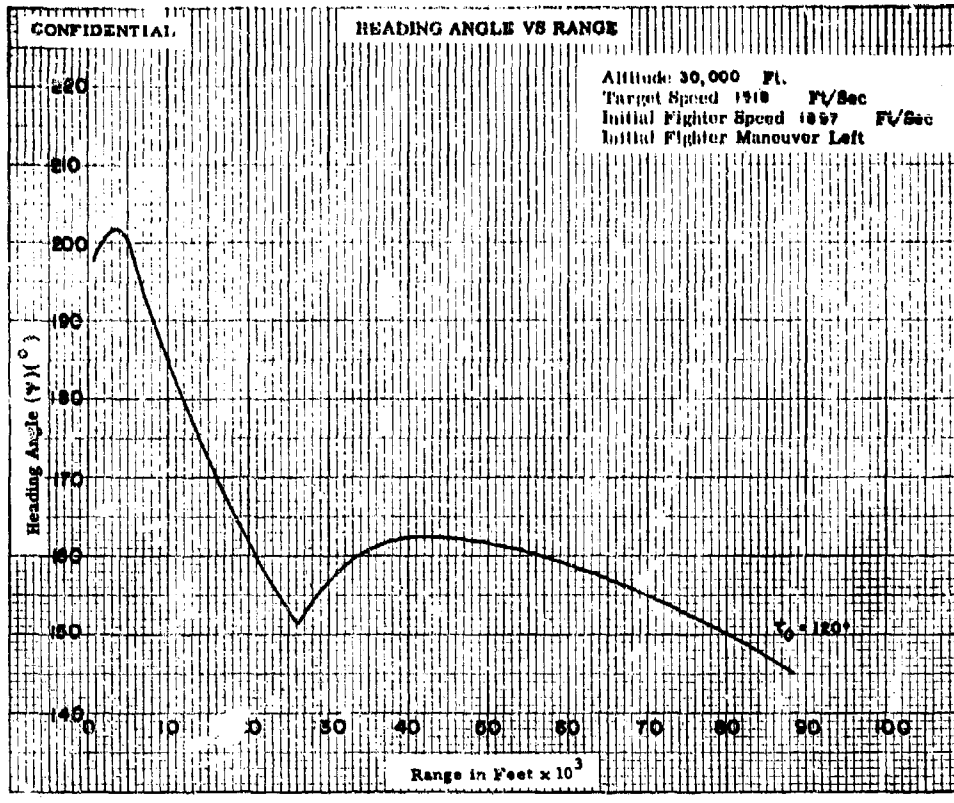

HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Heading Angle (Ψ)(°)
200
190
180
170
160
150
140
130
120
0
20
40
60
80
100
120
140
160
180
200
CONFIDENTIAL
Range in Feet x 10^3

Fig. XI-8b


CONFIDENTIAL
HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1918 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Heading Angle (Ψ)(°)
220
210
200
190
180
170
160
150
140
T_0 = 120°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

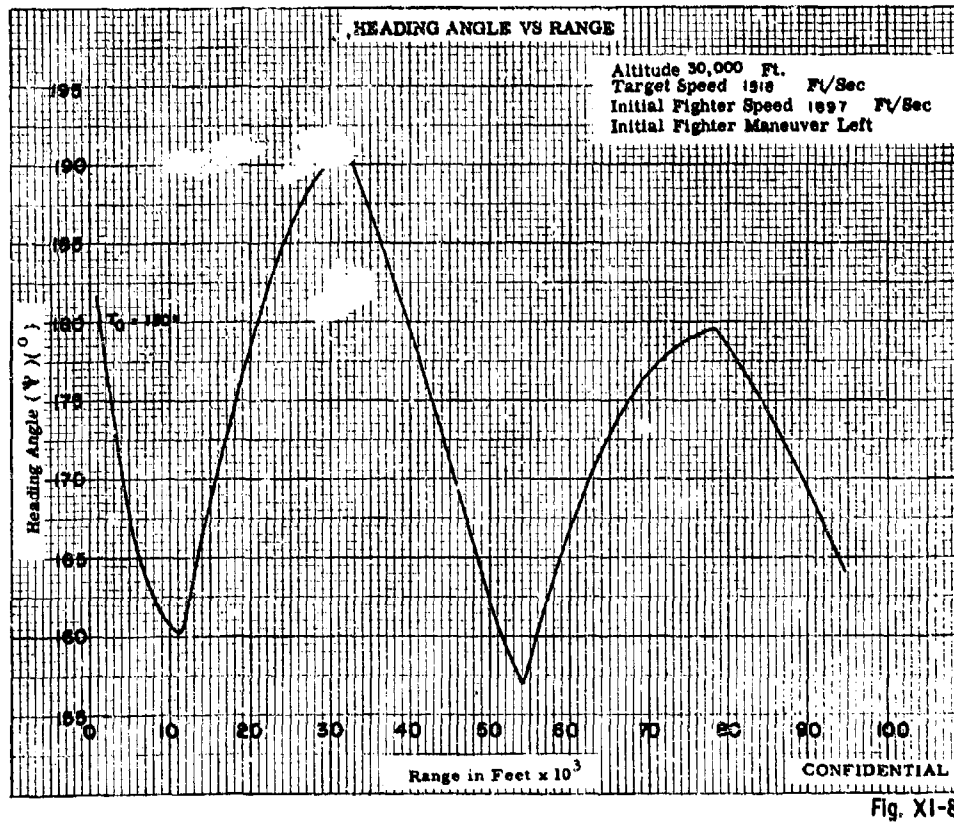
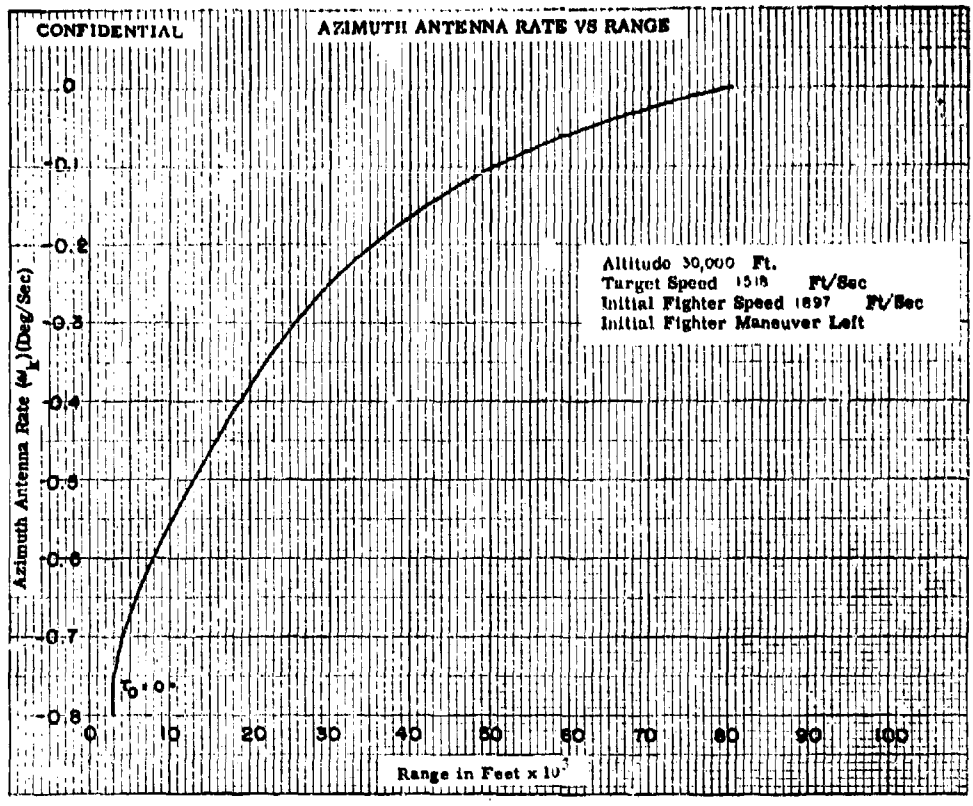

HEADING ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1918 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Heading Angle (Ψ)(°)
195
190
185
T_0 = 180°
175
170
165
160
155
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-8c


CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Antenna Rate ($\dot{\psi}_A$) (Deg/Sec)
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
$\psi_D = 0°$
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

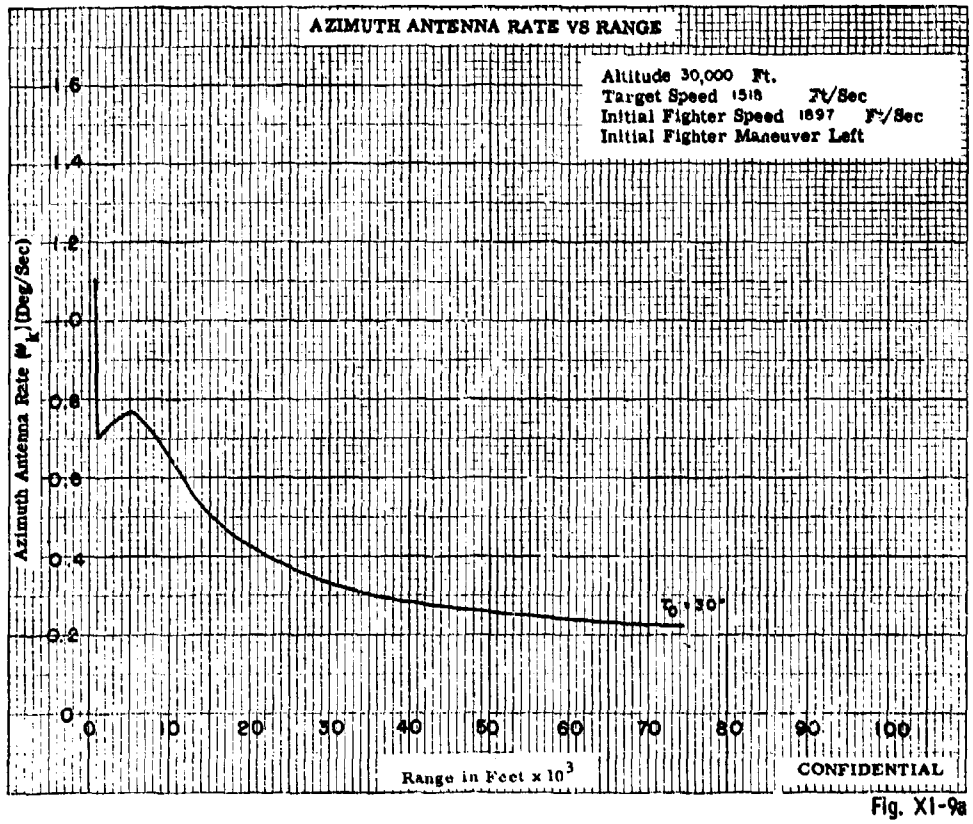
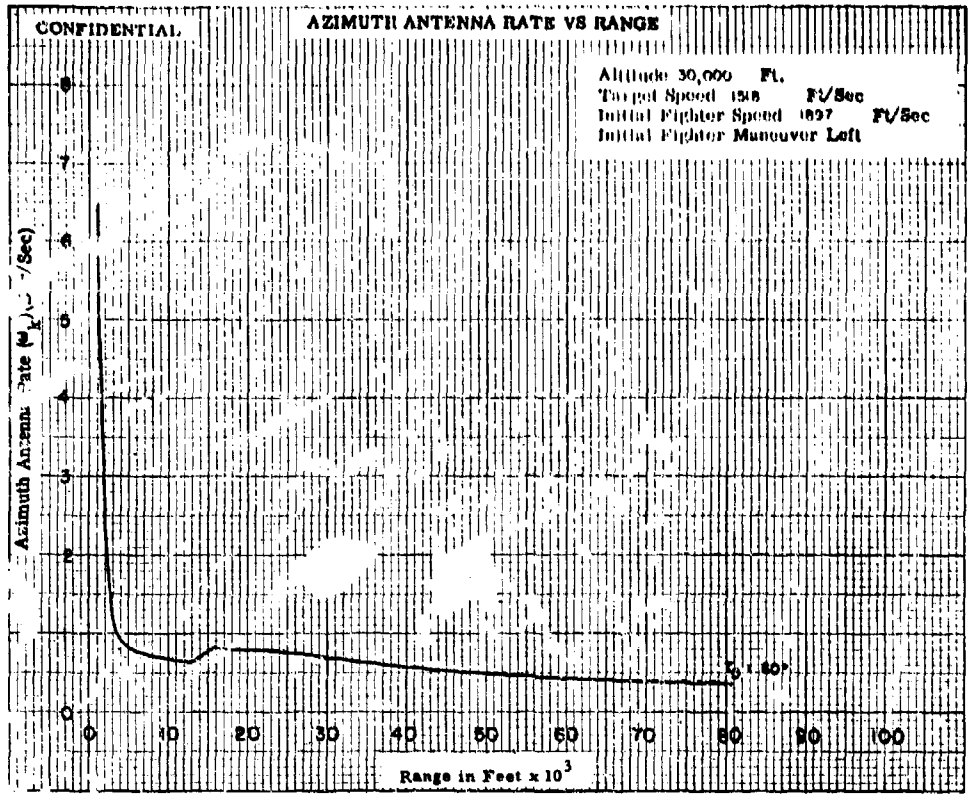

AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Antenna Rate ($\dot{\psi}_A$) (Deg/Sec)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
$\psi_D = 30°$
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-9a


CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Antenna Rate (ωk) (Deg/Sec)
Range in Feet x 10^3
0
10
20
30
40
50
60
70
80
90
100

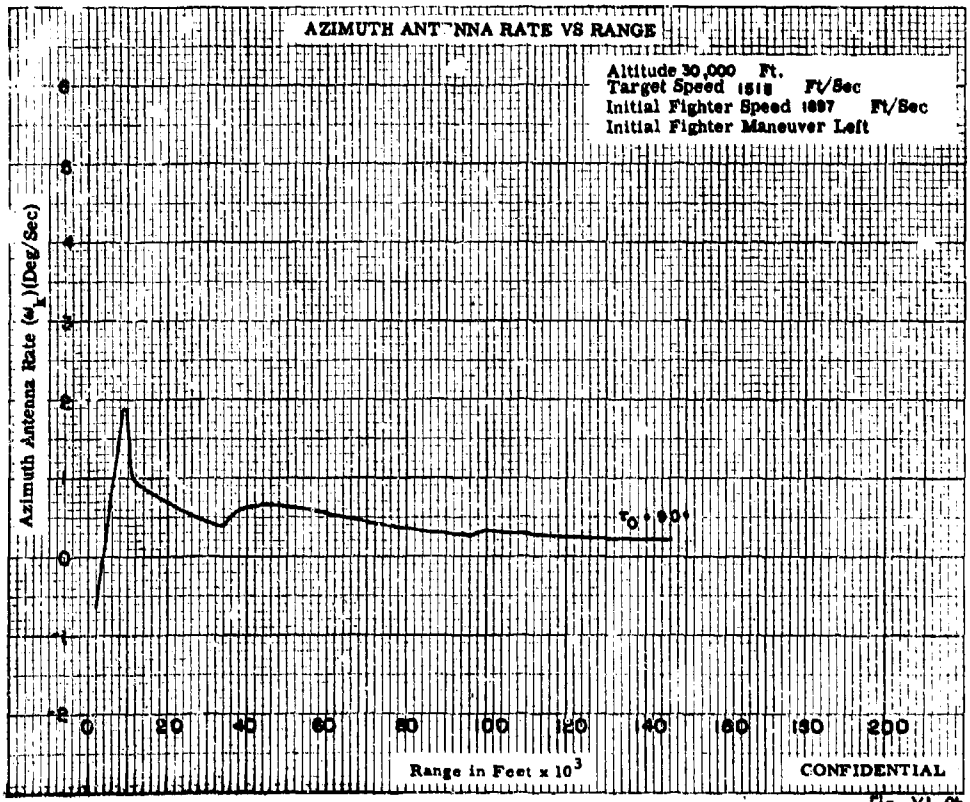
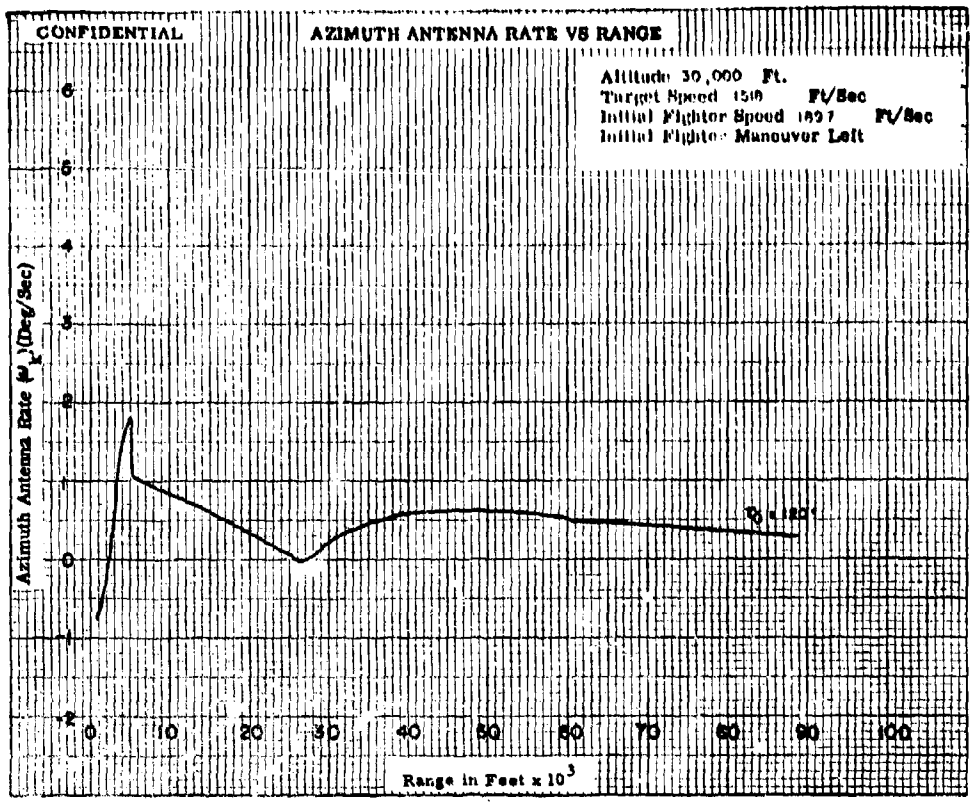

AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Antenna Rate (ωk) (Deg/Sec)
Range in Feet x 10^3
0
20
40
60
80
100
120
140
160
180
200
CONFIDENTIAL

Fig. XI-9b


CONFIDENTIAL
AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1510 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Antenna Rate ($\dot{\mu}_k$) (Deg/Sec)
θ_0 = 120°
Range in Feet x 10^3

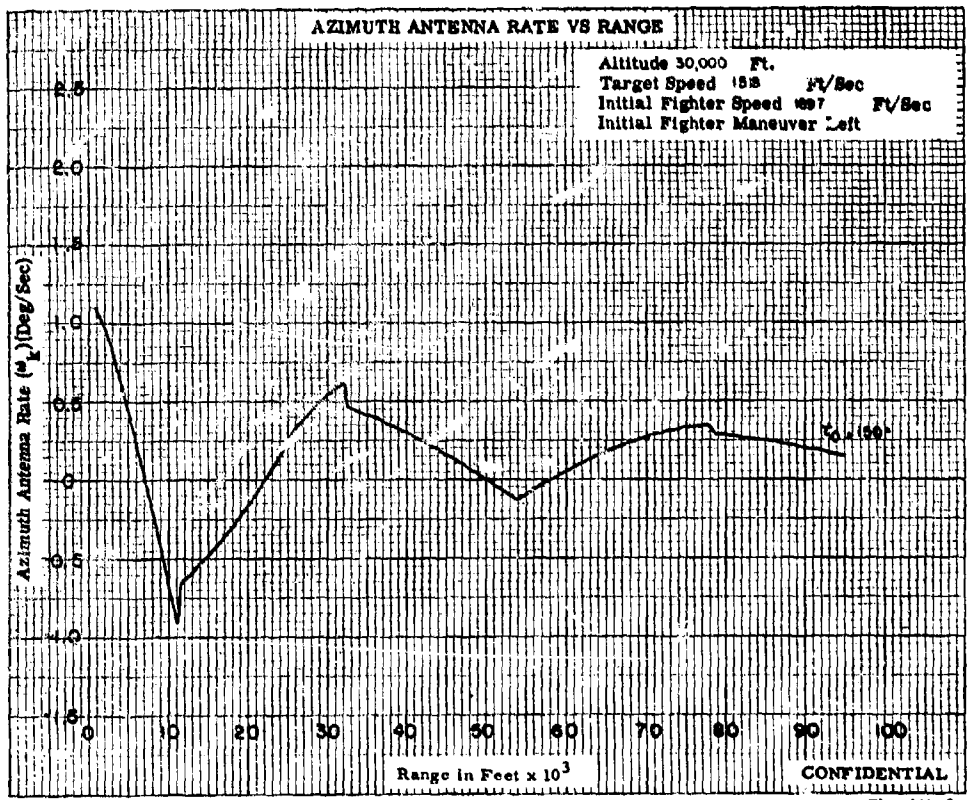
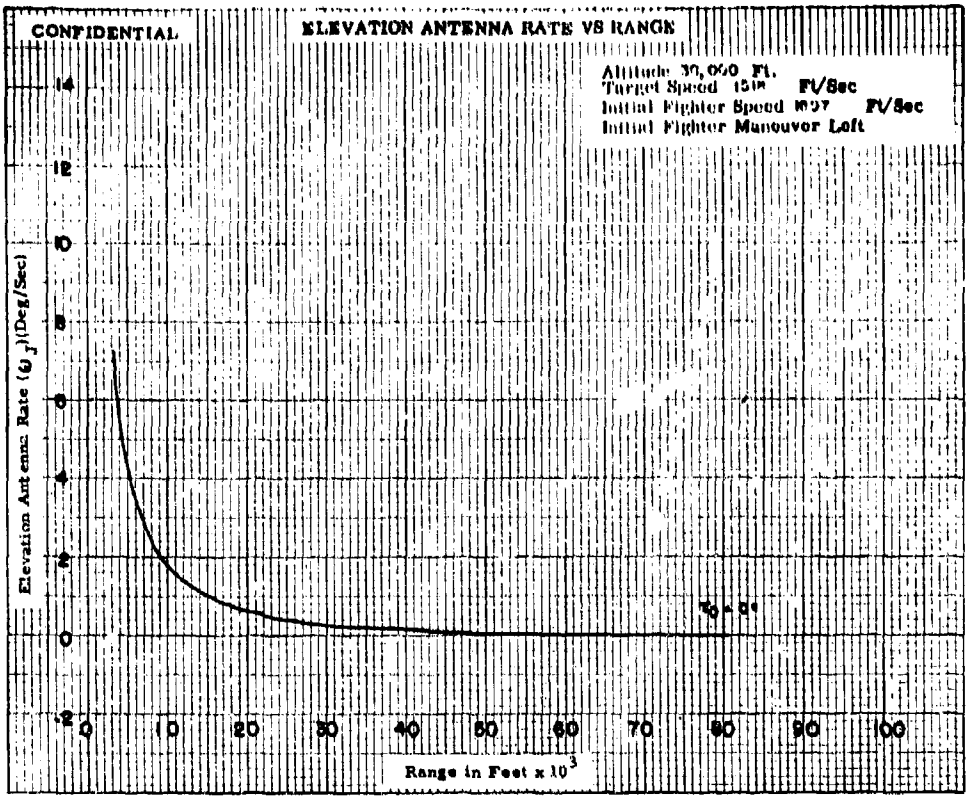

AZIMUTH ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1515 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Azimuth Antenna Rate ($\dot{\mu}_k$) (Deg/Sec)
θ_0 = 150°
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-9c


ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Elevation Antenna Rate (ω y)(Deg/Sec)
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

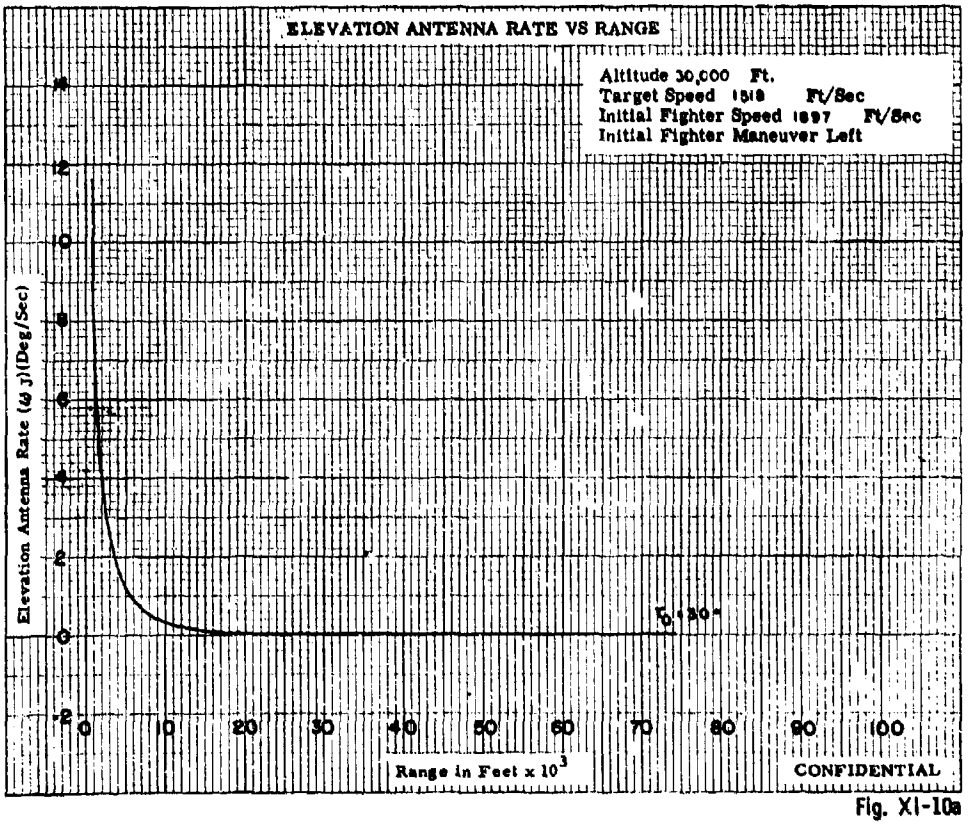
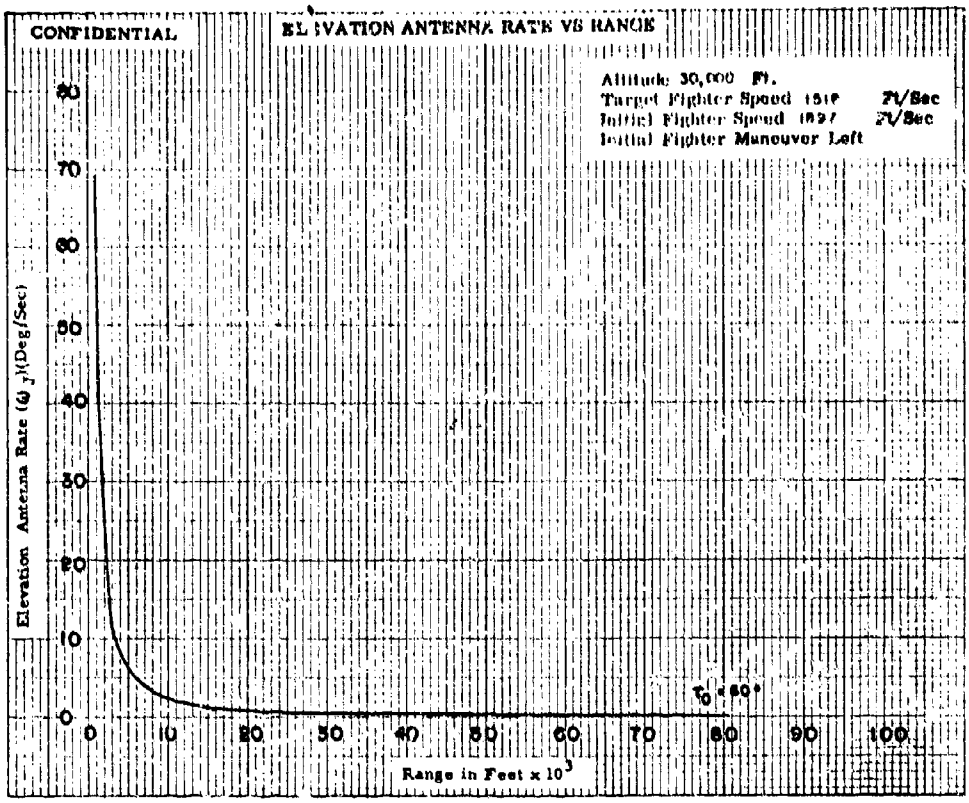

ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Elevation Antenna Rate (ω y)(Deg/Sec)
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-10a


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Elevation Antenna Rate (ω f)(Deg/Sec)
80
70
60
50
40
30
20
10
0
τ_0 = 60°
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

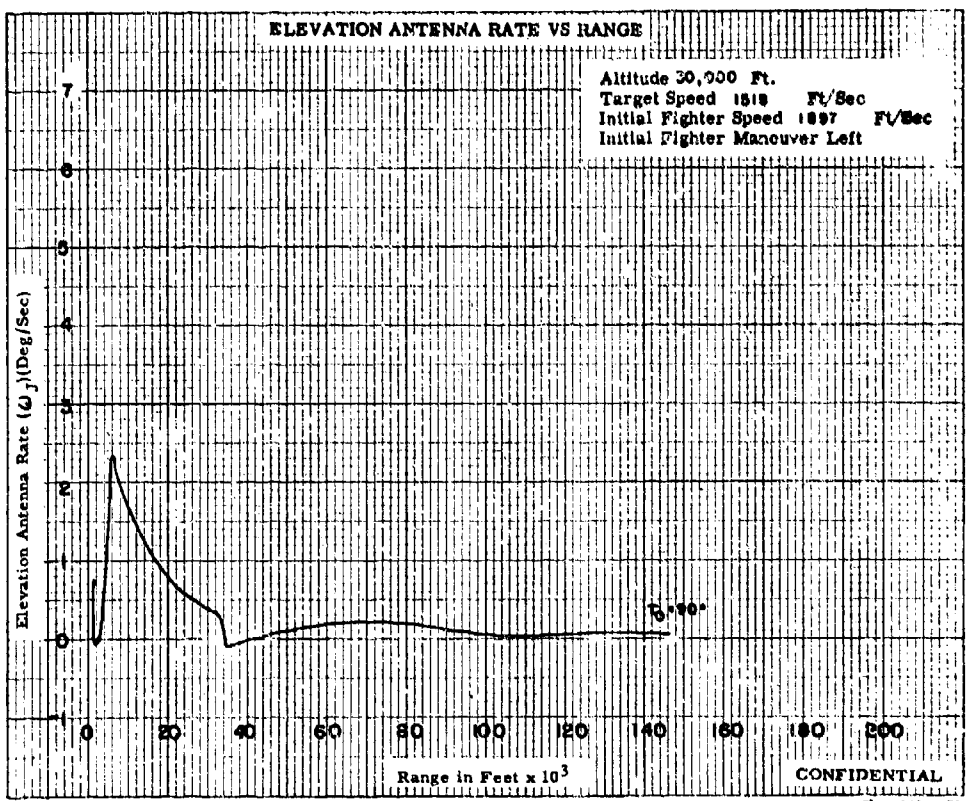
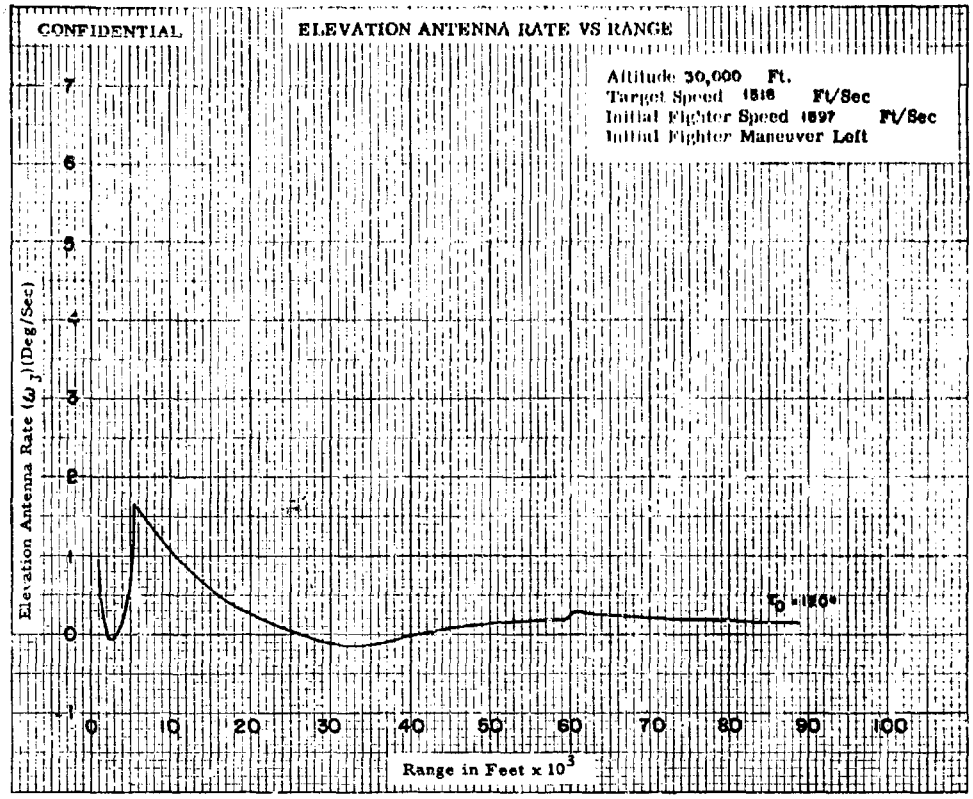

ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Elevation Antenna Rate (ω f)(Deg/Sec)
7
6
5
4
3
2
1
0
-1
τ_0=90°
0
20
40
60
80
100
120
140
160
180
200
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-10b


CONFIDENTIAL
ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Elevation Antenna Rate (ω_y)(Deg/Sec)
7
6
5
4
3
2
1
0
-1
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
τ_D = 120°

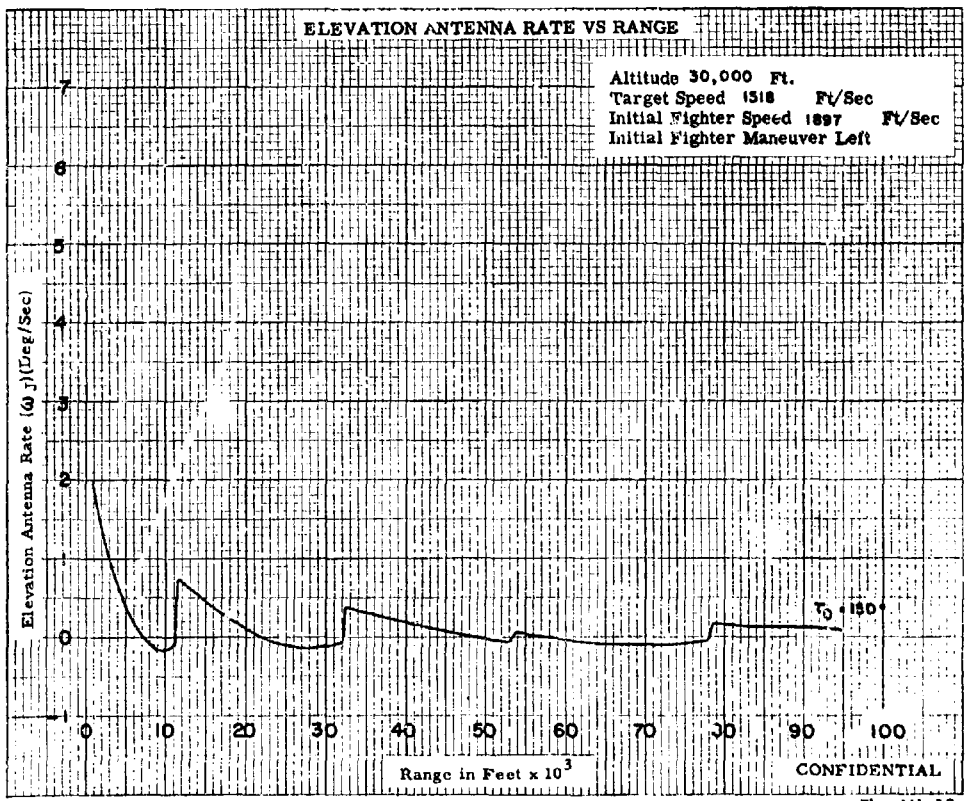
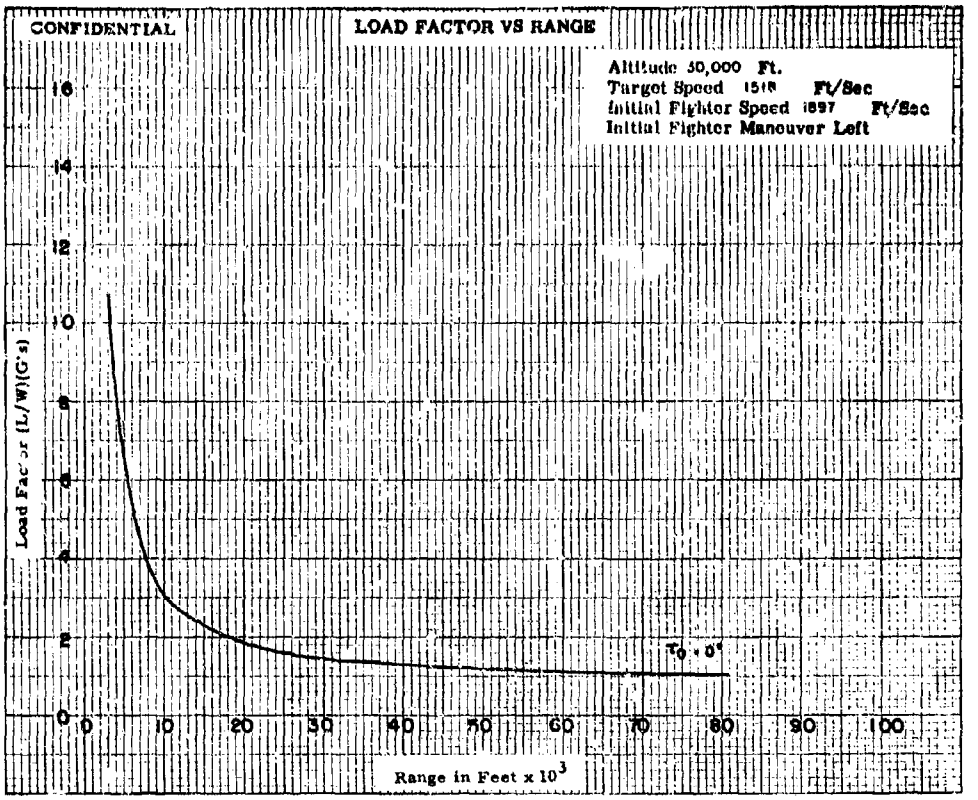

ELEVATION ANTENNA RATE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Elevation Antenna Rate (ω_y)(Deg/Sec)
7
6
5
4
3
2
1
0
-1
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3
τ_D = 150°
CONFIDENTIAL

Fig. XI-10c


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Load Factor (L/W)(G's)
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100
τ_0 = 0°
Range in Feet x 10^3

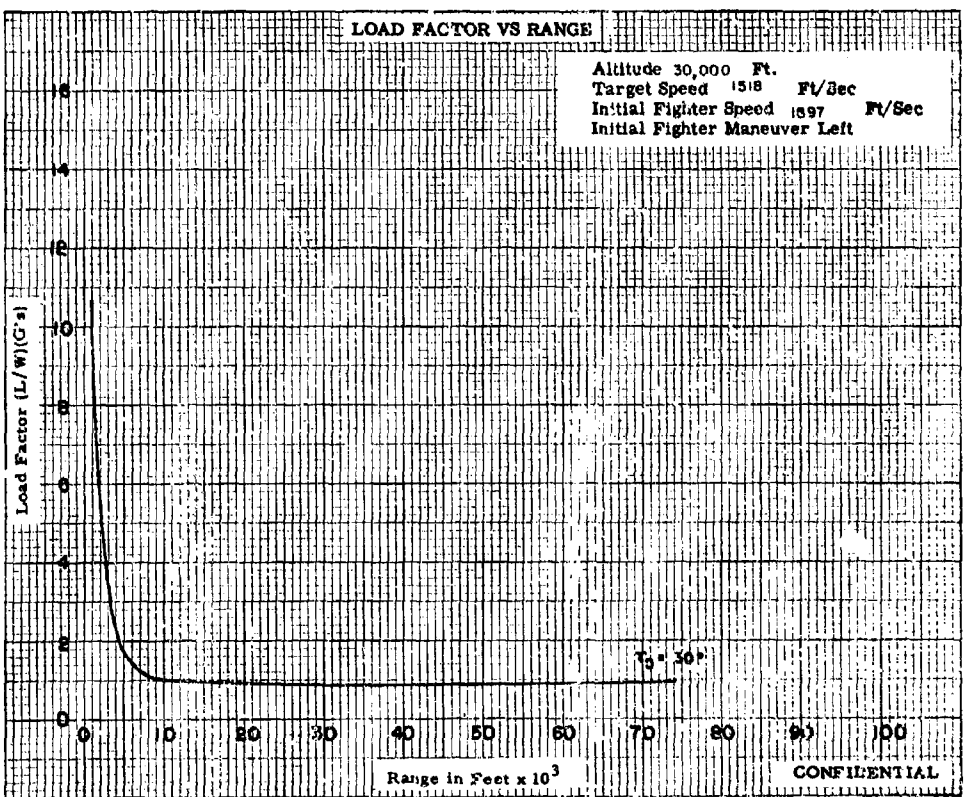
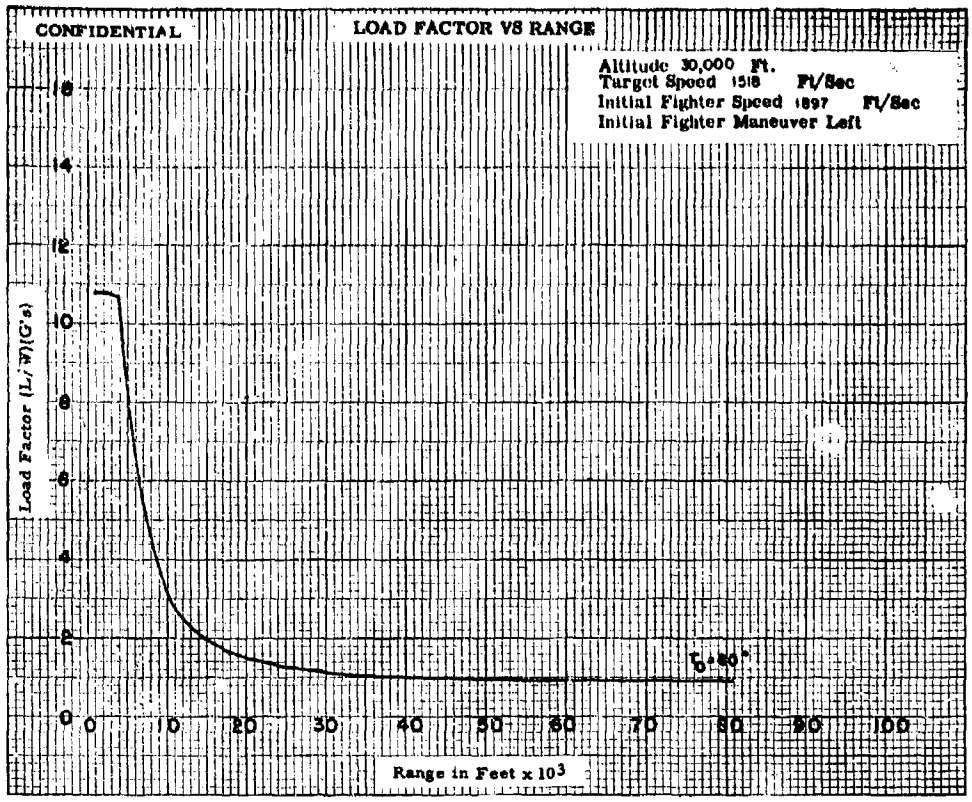

LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Load Factor (L/W)(G's)
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100
τ_0 = 30°
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-11a


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Load Factor (L/W)(G's)
16
14
12
10
8
6
4
2
0
T_0 = 90°
0 10 20 30 40 50 60 70 80 90 100
Range in Feet x 10^3

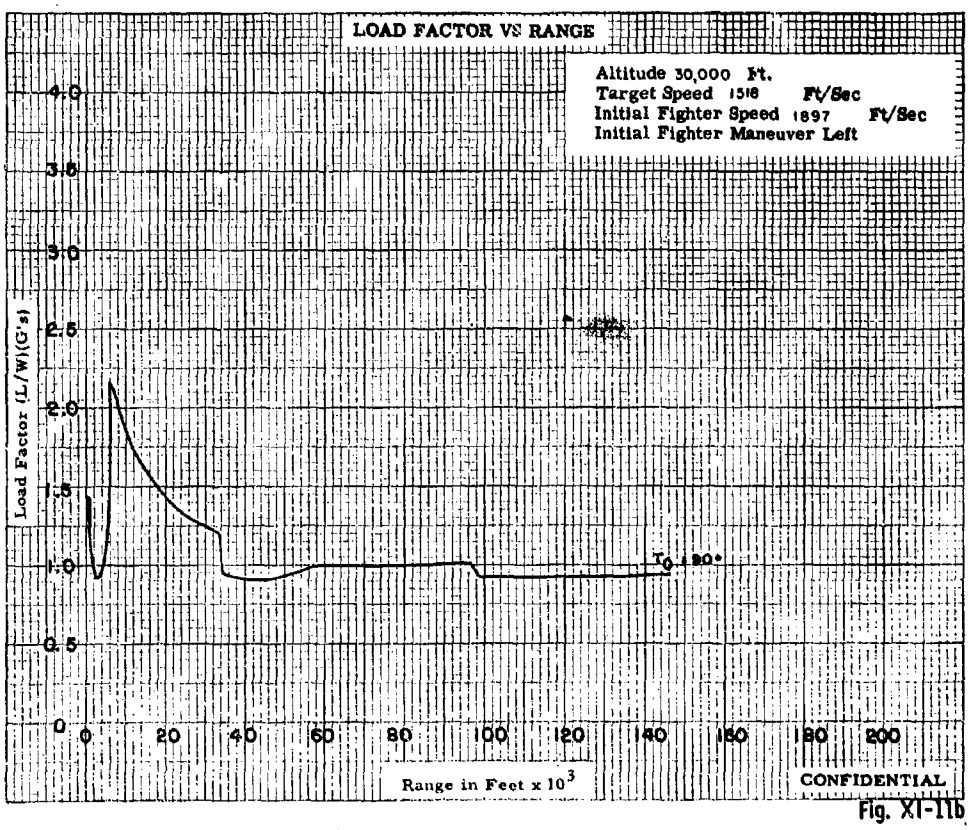
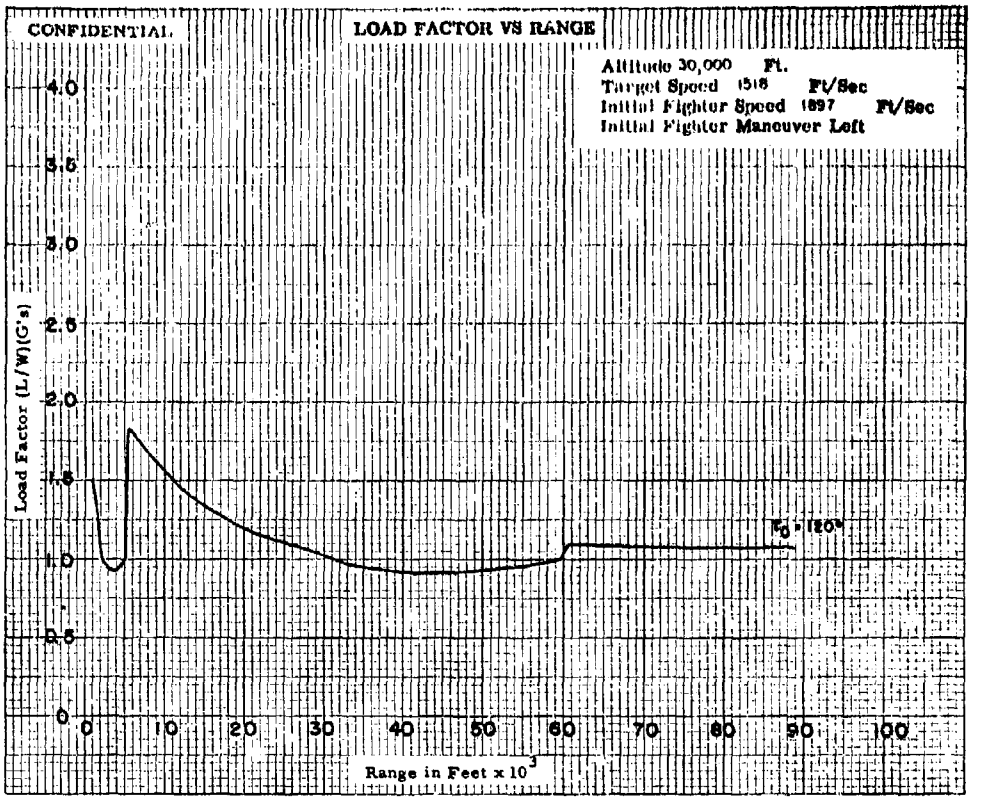

LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Load Factor (L/W)(G's)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
T_0 = 90°
0 20 40 60 80 100 120 140 160 180 200
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-11b


CONFIDENTIAL
LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Load Factor (L/W)(G's)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
$\psi_0 = 120°$
0 10 20 30 40 50 60 70 80 90 100
Range in Feet x 10^3

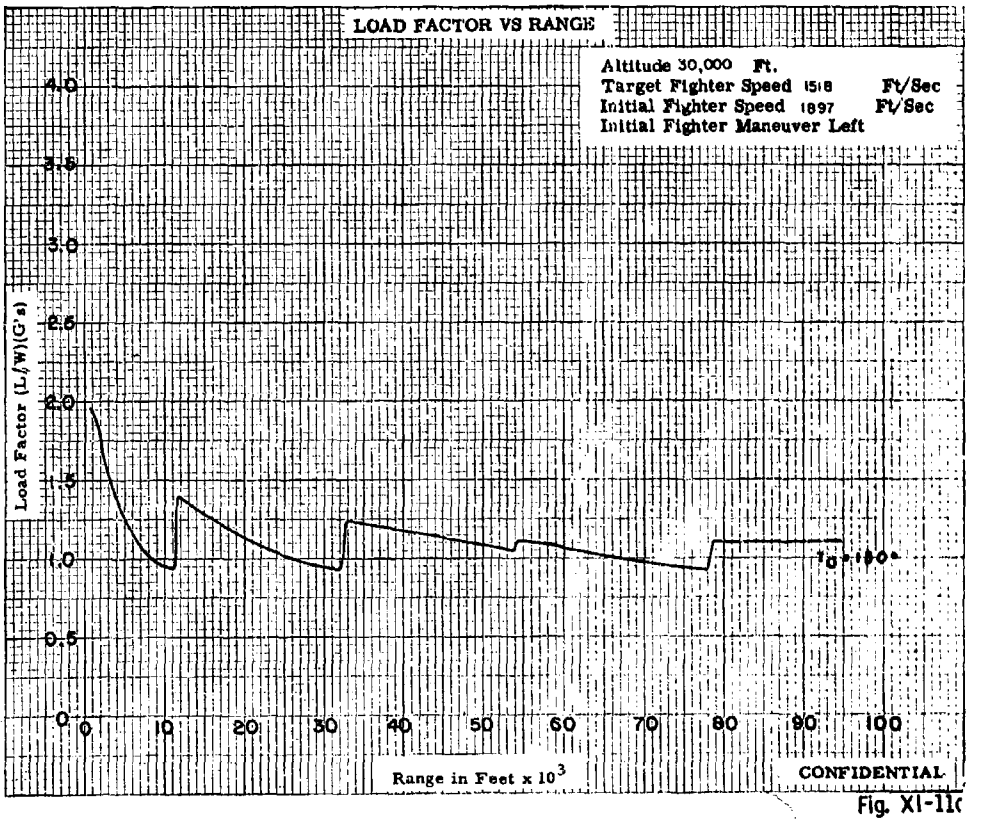
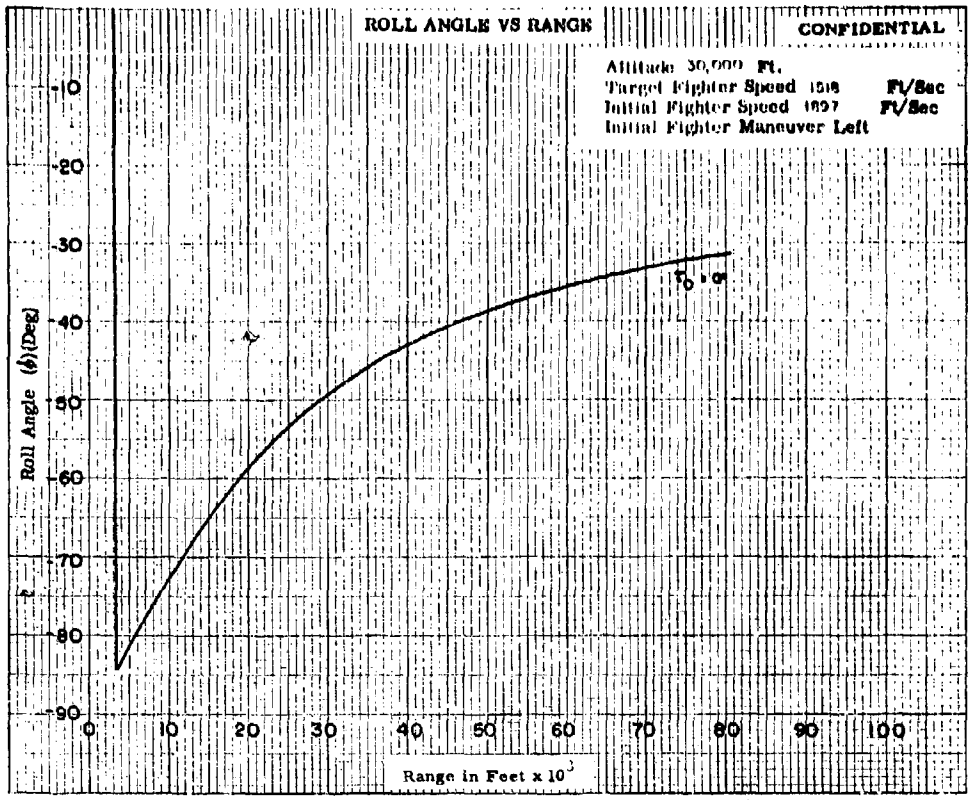

LOAD FACTOR VS RANGE
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Load Factor (L/W)(G's)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
$\psi_0 = 180°$
0 10 20 30 40 50 60 70 80 90 100
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-11


ROLL ANGLE VS RANGE
CONFIDENTIAL
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
$\tau_0 = 0^\circ$
Roll Angle (φ)(Deg)
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
10
20
30
40
50
60
70
80
90
100
Range in Feet x 10^3

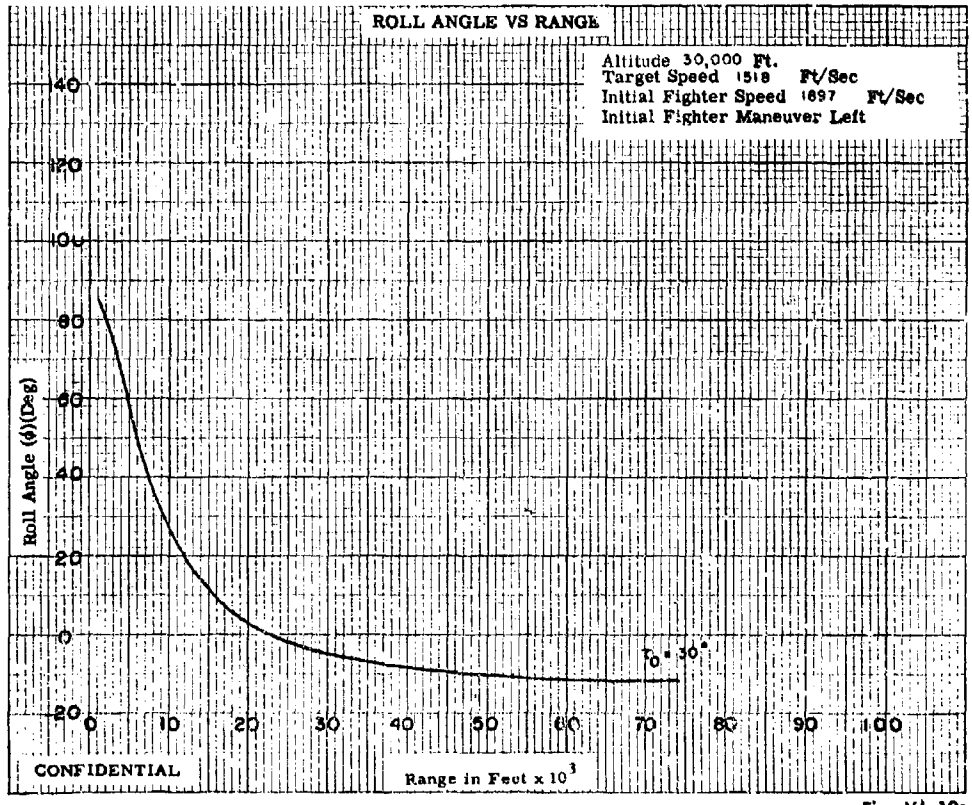
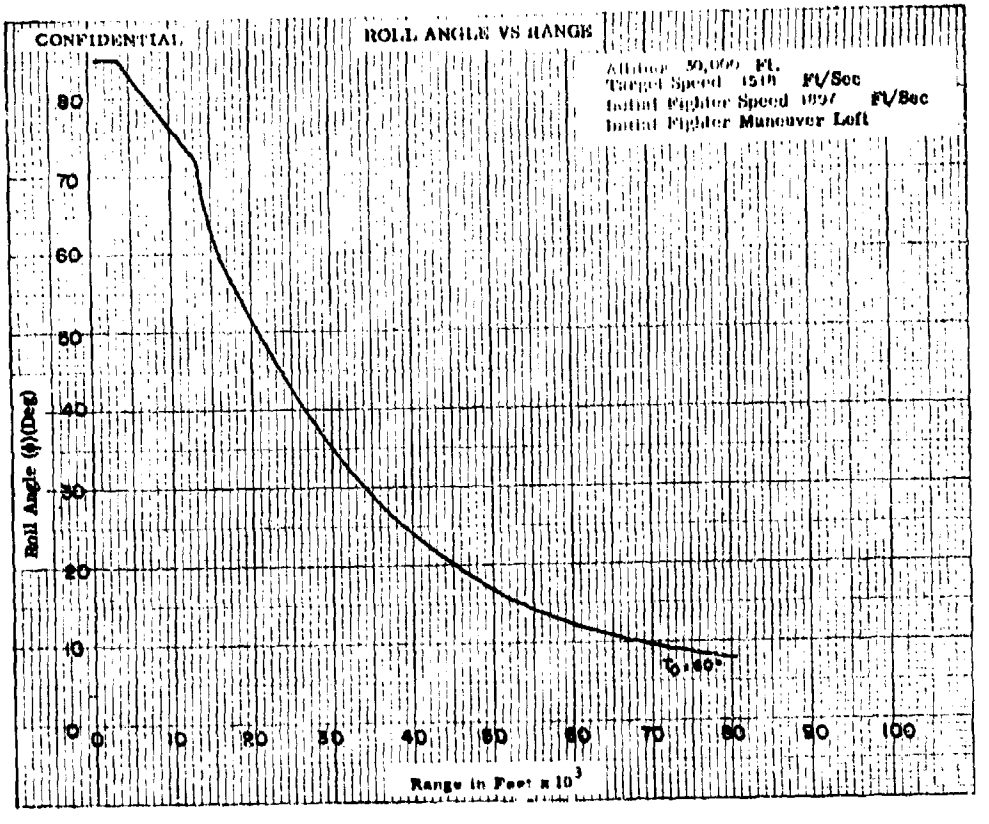

ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
$\tau_0 = 30^\circ$
Roll Angle (φ)(Deg)
140
120
100
80
60
40
20
0
-20
0
10
20
30
40
50
60
70
80
90
100
CONFIDENTIAL
Range in Feet x 10^3

Fig. XI-12a


CONFIDENTIAL
ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Roll Angle (φ)(Deg)
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
T_0 =40"
Range in Feet x 10^3

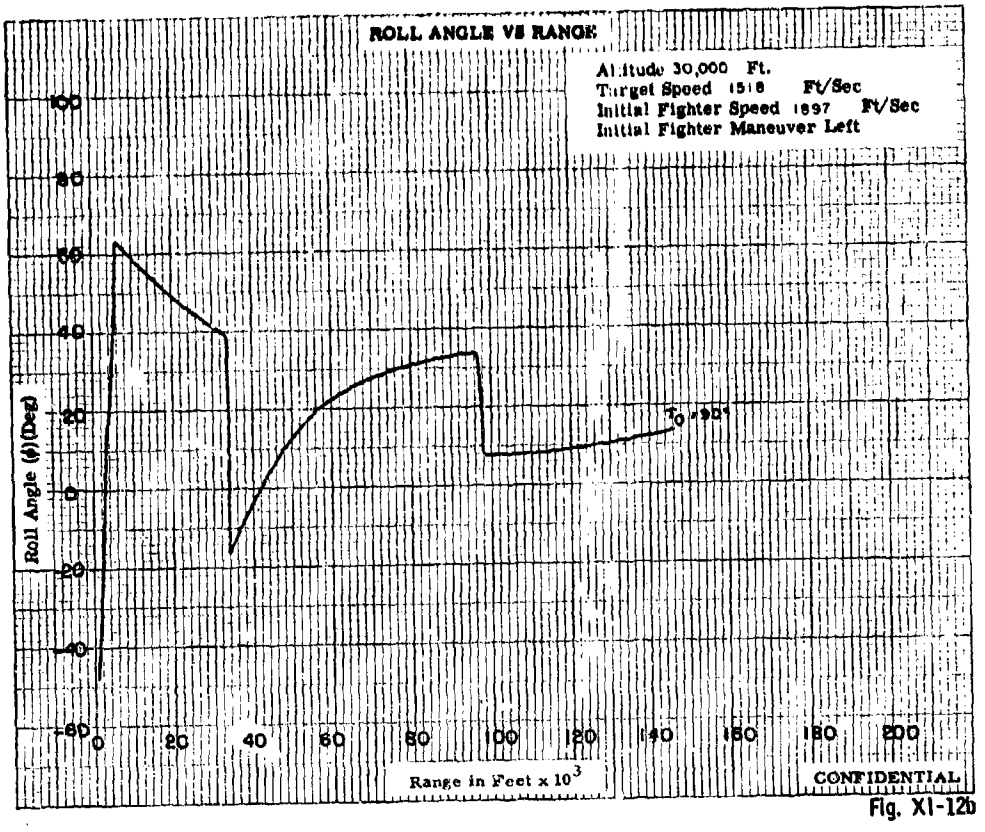
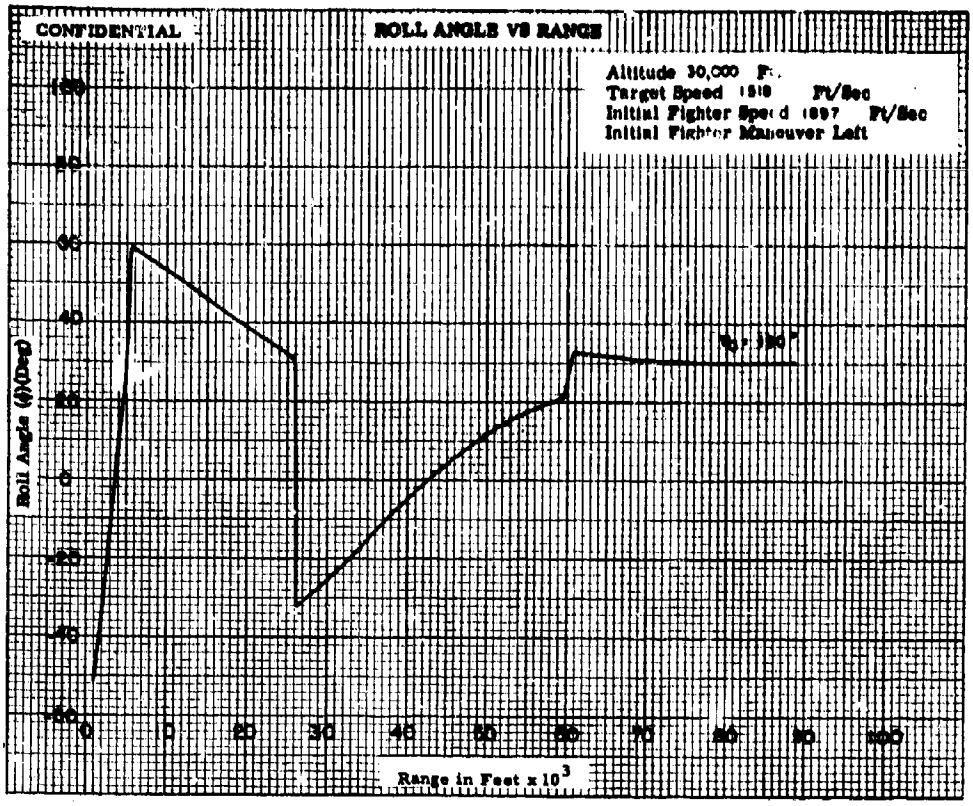

ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Roll Angle (φ)(Deg)
100
80
60
40
20
0
-20
-40
-60
0
20
40
60
80
100
120
140
160
180
200
T_0 =92"
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-12b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ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1097 Ft/Sec
Initial Fighter Maneuver Left
Roll Angle (φ)(Deg)
Range in Feet x 10^3

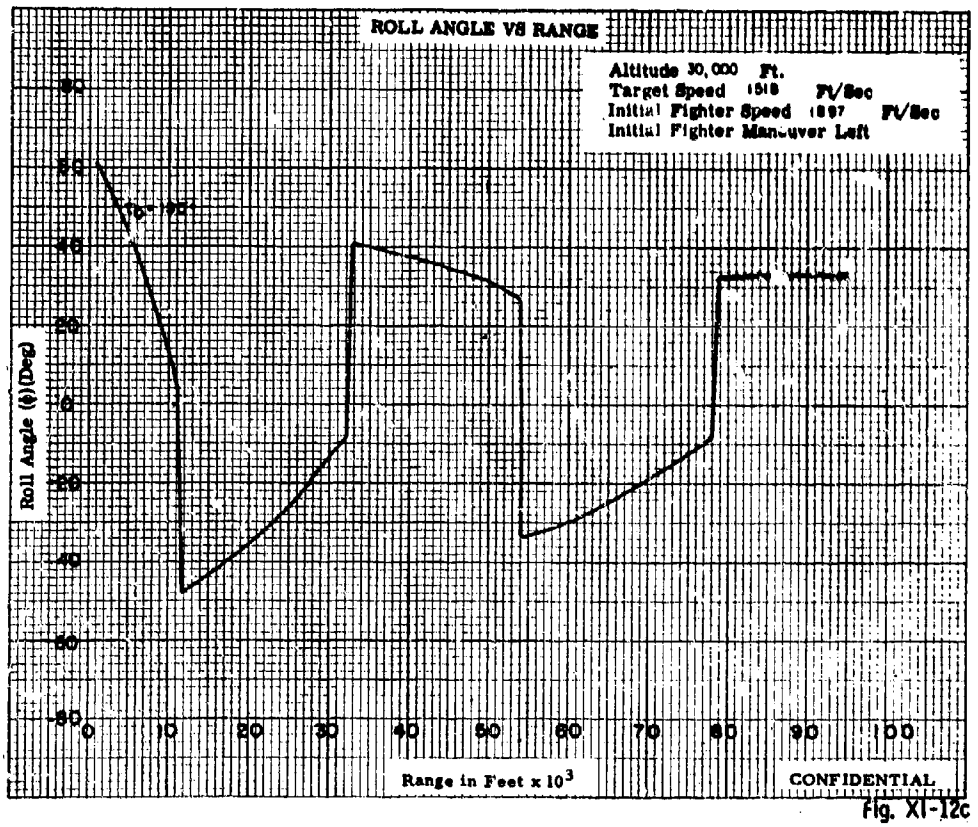
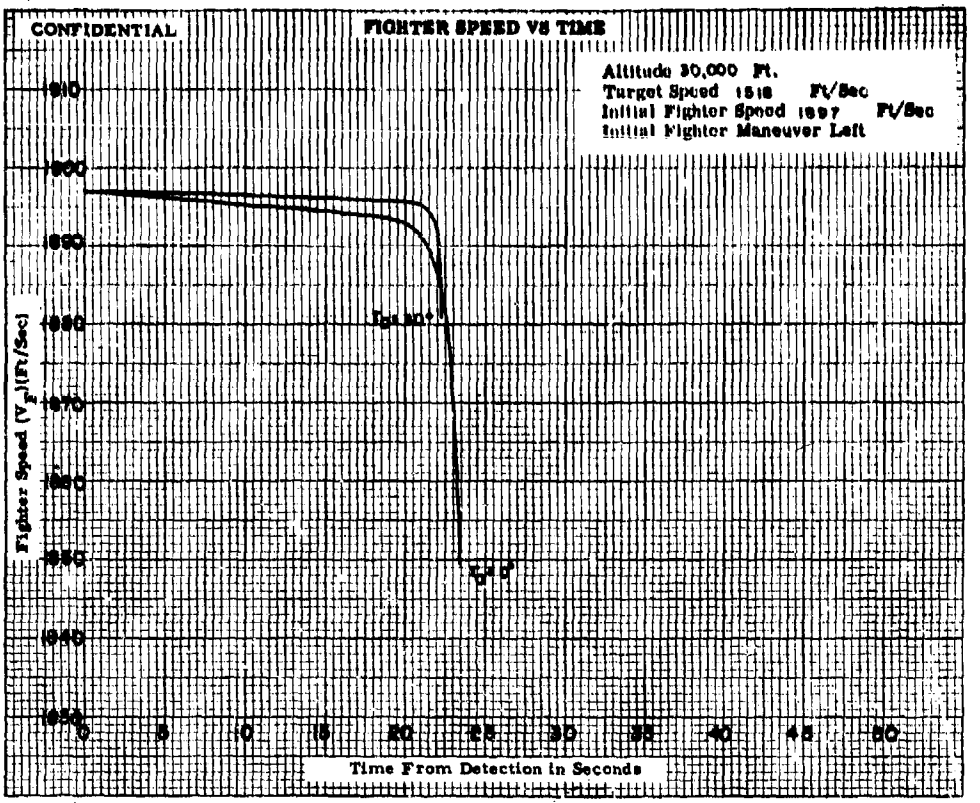

ROLL ANGLE VS RANGE
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1097 Ft/Sec
Initial Fighter Maneuver Left
Roll Angle (φ)(Deg)
Range in Feet x 10^3
CONFIDENTIAL

Fig. XI-12c


CONFIDENTIAL
FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Fighter Speed (V_F)(Ft/Sec)
1910
1900
1890
1880
1870
1860
1850
1840
1830
T_Q=0°
0
5
10
15
20
25
30
35
40
45
50
Time From Detection in Seconds

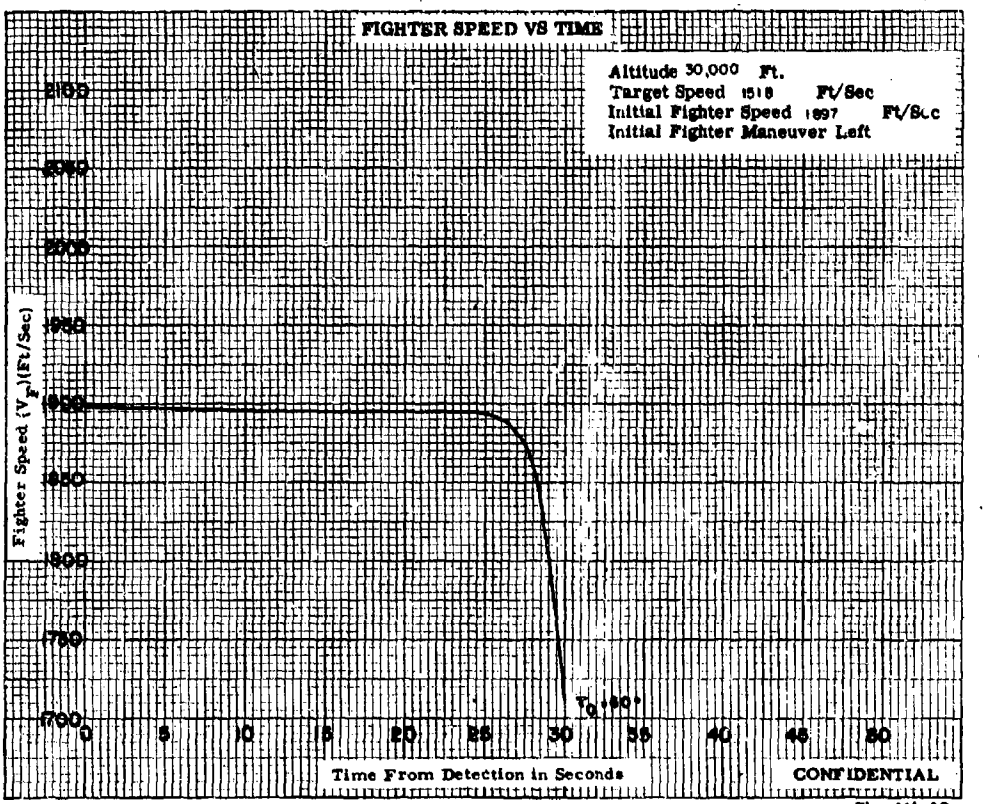
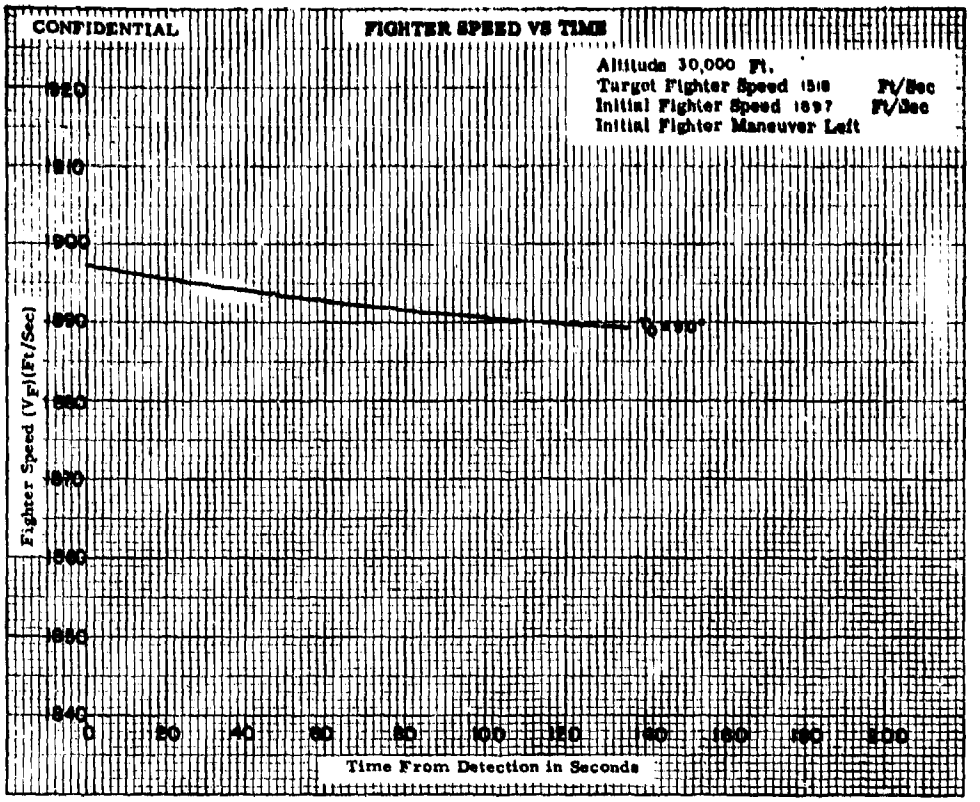

FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Fighter Speed (V_F)(Ft/Sec)
2100
2000
1950
1900
1850
1800
1750
1700
T_Q=90°
0
5
10
15
20
25
30
35
40
45
50
Time From Detection in Seconds
CONFIDENTIAL

Fig. XI-13a


CONFIDENTIAL
FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Fighter Speed (V_F)(Ft/Sec)
1920
1910
1900
1890
1880
1870
1860
1850
1840
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds

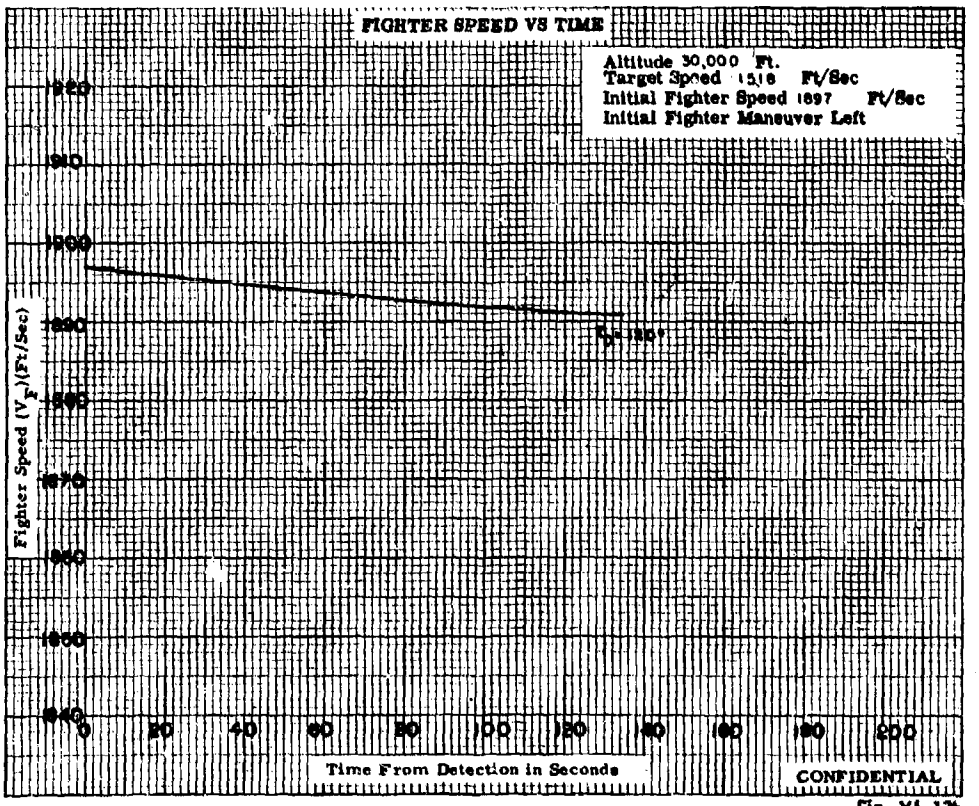

FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
Fighter Speed (V_F)(Ft/Sec)
1920
1910
1900
1890
1880
1870
1860
1850
1840
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds
CONFIDENTIAL

Fig. XI-13b

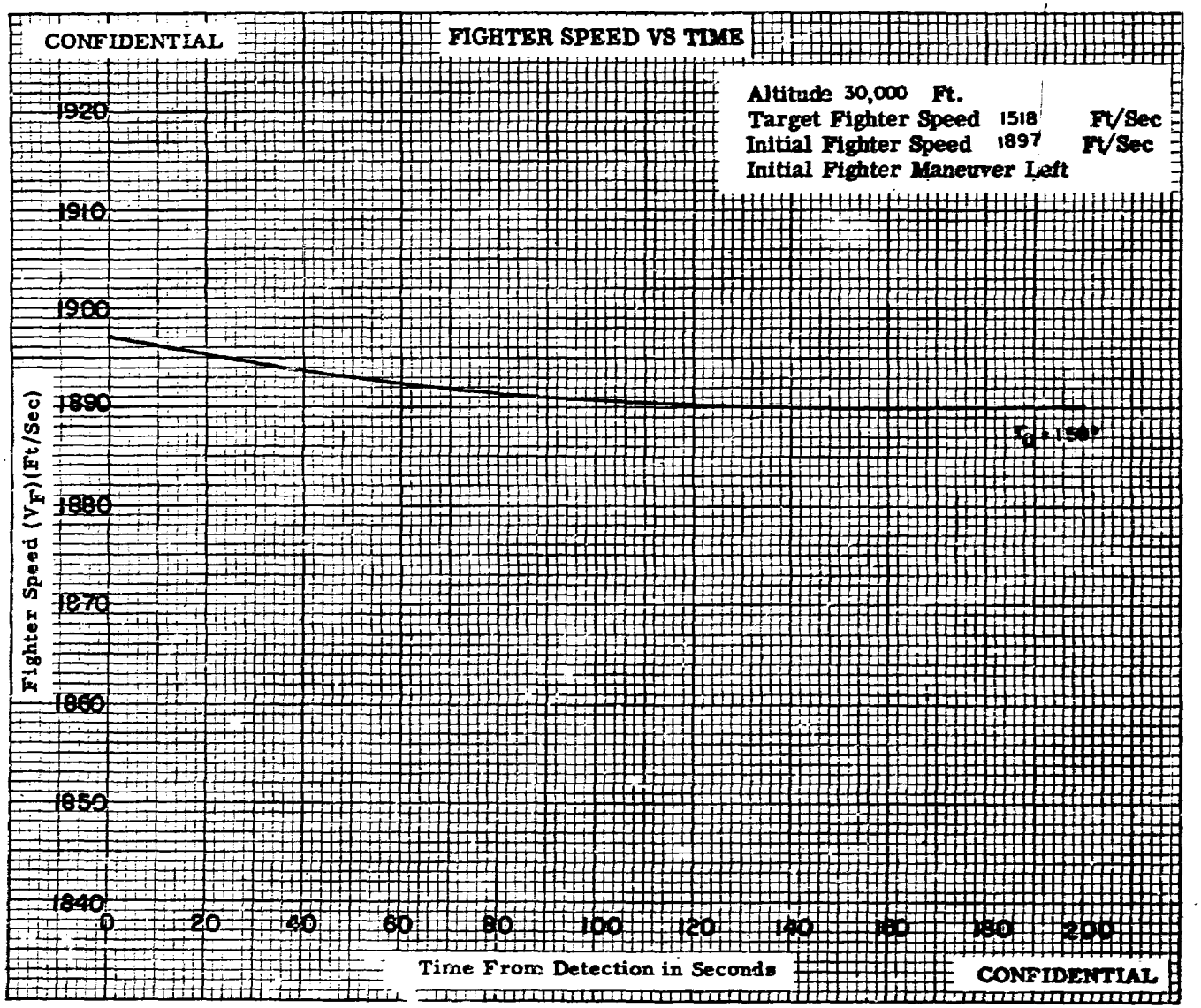
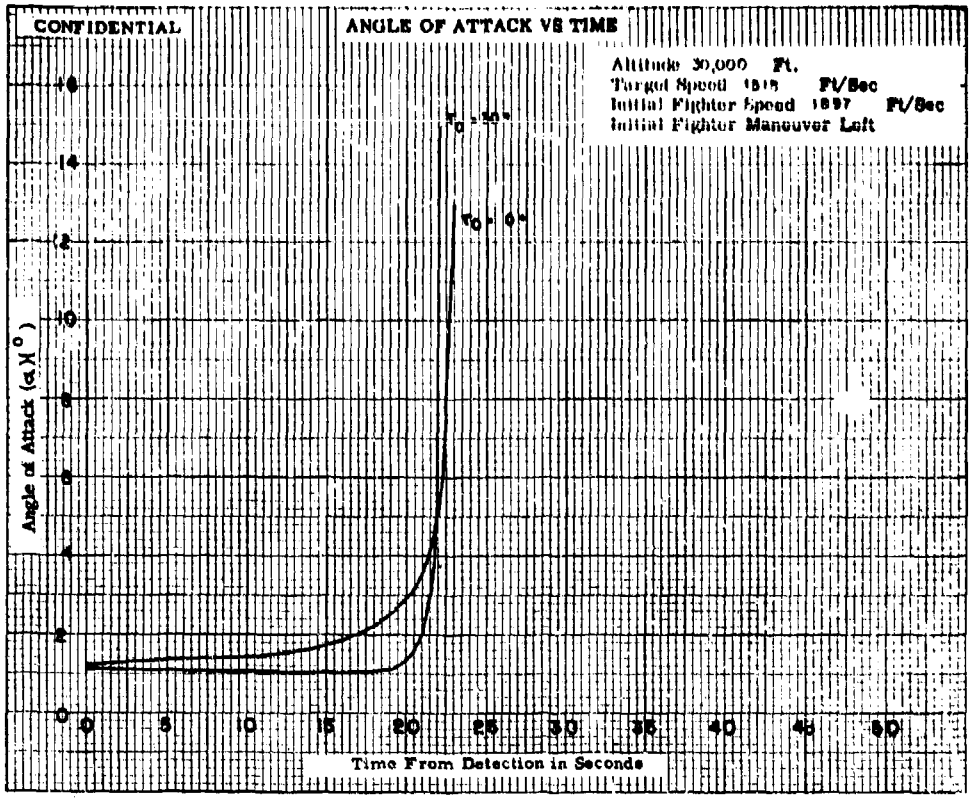

CONFIDENTIAL
FIGHTER SPEED VS TIME
Altitude 30,000 Ft.
Target Fighter Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
1920
1910
1900
1890
1880
1870
1860
1850
1840
Fighter Speed (V_F)(Ft/Sec)
ψ_d = 150°
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds
CONFIDENTIAL

Fig. XI-13c


CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Angle of Attack (α) (°)
Time From Detection in Seconds

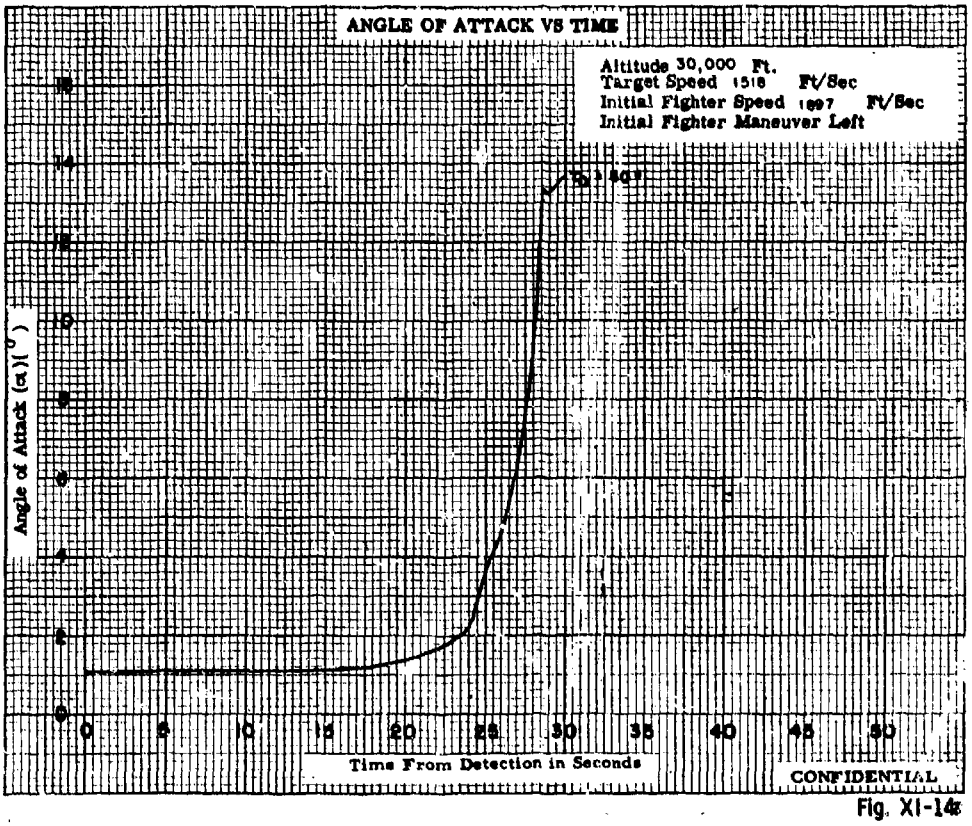
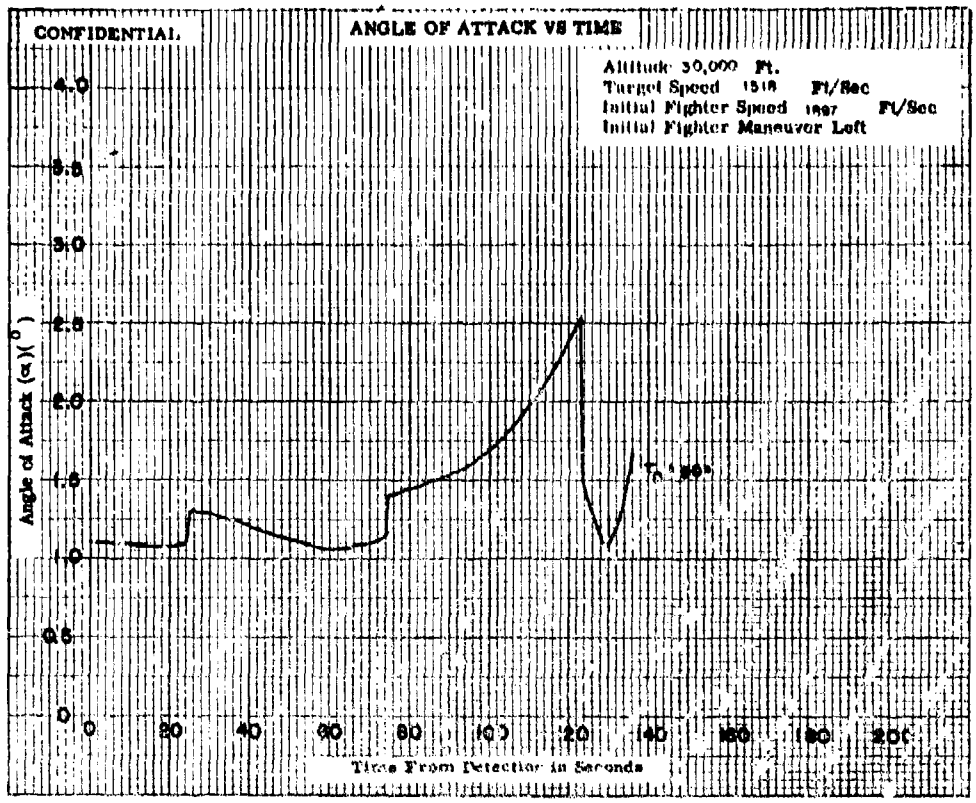

ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Angle of Attack (α) (°)
Time From Detection in Seconds
CONFIDENTIAL

Fig. XI-14


CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Angle of Attack (α)(°)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0 20 40 60 80 100 120 140 160 180 200
Time From Detection in Seconds

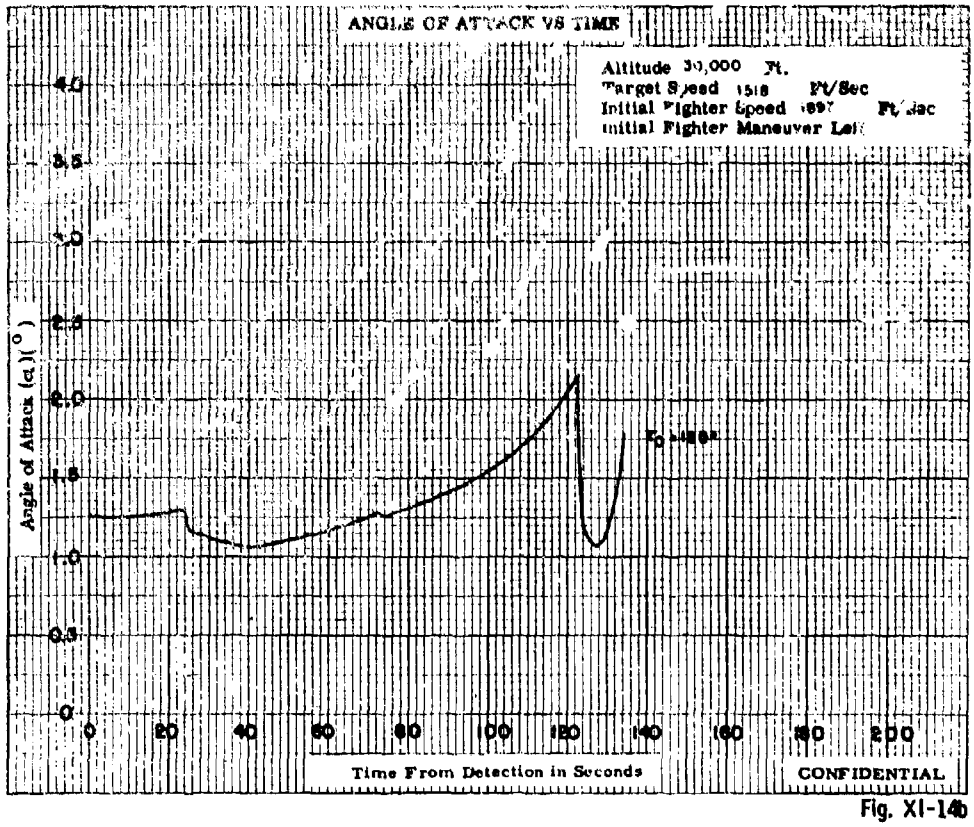

ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1697 Ft/Sec
Initial Fighter Maneuver Left
Angle of Attack (α)(°)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0 20 40 60 80 100 120 140 160 180 200
Time From Detection in Seconds
CONFIDENTIAL

Fig. XI-14b

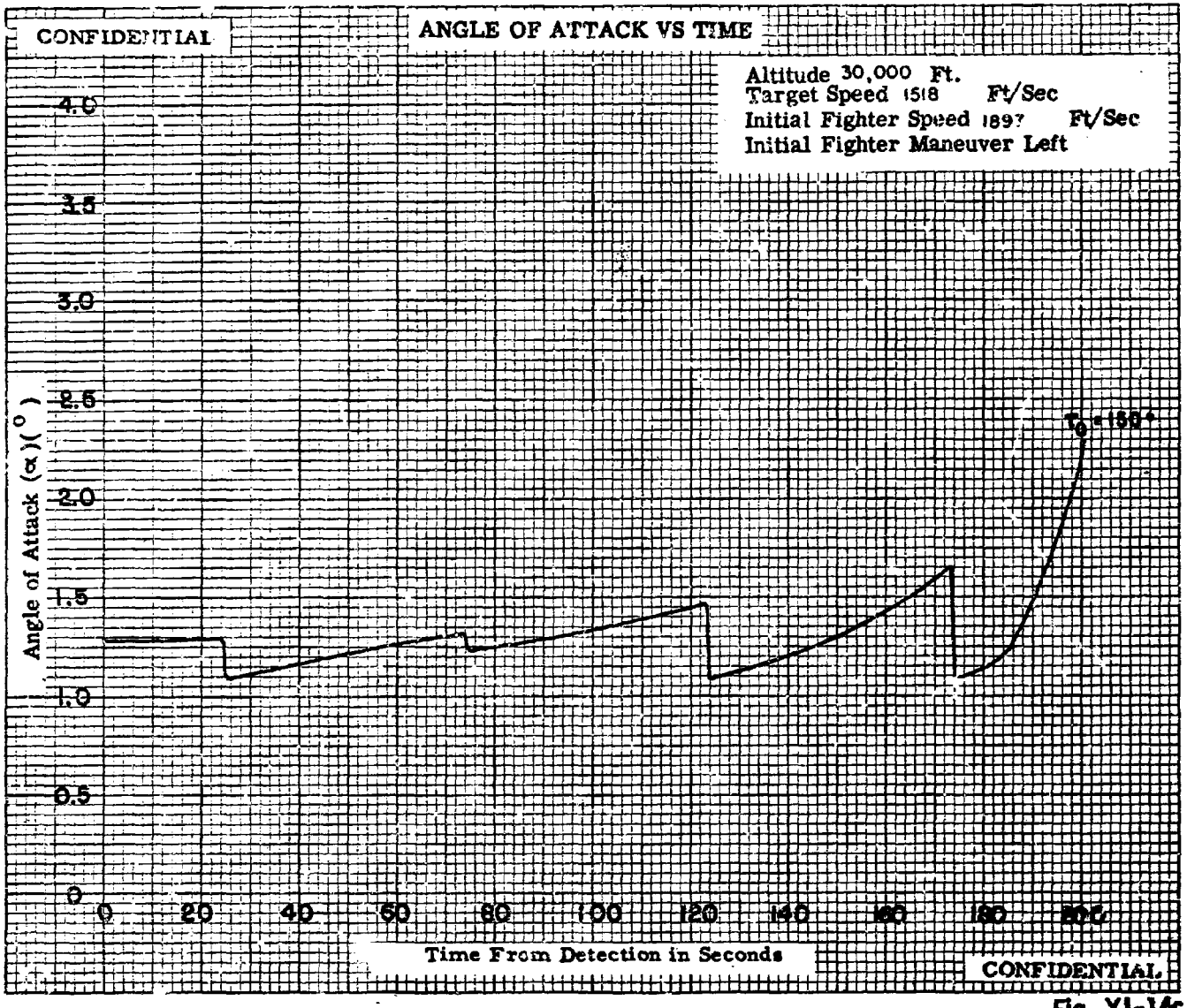

CONFIDENTIAL
ANGLE OF ATTACK VS TIME
Altitude 30,000 Ft.
Target Speed 1518 Ft/Sec
Initial Fighter Speed 1897 Ft/Sec
Initial Fighter Maneuver Left
T_0 = 150°
Angle of Attack (α)(°)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
20
40
60
80
100
120
140
160
180
200
Time From Detection in Seconds
CONFIDENTIAL

Fig. XI-14c

Naval Research Laboratory
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TO: **Code 5300 Paul Hughes**

CC: Tina Smallwood, Code 1221.1 ts 3/8/01

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   ☐ Possible Change in Classification

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Mary Templeman

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TI (6) SUMMARY OF NAVY STUDY PROGRAM FOR F4H-1 AND F8U-3 WEAPON SYSTEMS. (PARAMETER PLOTS FOR CO-ALTITUDE ATTACKS). VOLUME VII.
DN (9) Memo. rept.
AU (10) Bellavin ,I. N.
Lister ,R. L.
Loughmiller ,C. M.
Ryon,J. C.
RD (11) 1958
PG (12) 248 Pages
RS (14) NRL-MR-754-Vol-7
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