

PART 1

SECTION 8—ATTACK SEQUENCES

CHAPTER 3—GUNS

Contents

	Para
Introduction	1
Interpretation of the Illustrations	4
Guns Radar Ranging	7
Guns Pure Pursuit (GPP)	8

Illustrations	Fig
Firing Zones	1
Relative Plot of Fighter Trajectory with Respect to Target	2
Typical Bullet Patterns	3

Introduction

1. Gun firing limitations are given in Pilot's Notes and the Release to Service.
2. The LFS is set for a fixed range of 375 yards and the recommended gun firing bracket is from 450 yards down to 300 yards depending on attack parameters, for example, overtake speed.
3. The problems and limitations associated with gun firing are similar in the Lightning to that of other aircraft fixed-gun installations but the high speed of the Lightning and the high incidence at low speeds produce additional complications. When firing at high airspeed against slow targets at short ranges, high values of normal acceleration are necessary to track the target. If low airspeed is used to fire at slow targets, the velocity vector of the aircraft tends to be well below the target track, leading to the need to break off the attack early to pull above the target, or to break off below the target. Because of the incidence problem, the guns are positioned along the horizontal fuselage datum in the Lightning F6 rather than along the wing chord line as in earlier Lightnings.

Interpretation of the Illustrations

4. Note: The firing range is now pegged at 400 yards,

corresponding to a fixed gyro sensitivity of 0.52 seconds. Fig 1, 2 and 3, however, were compiled for an original pegged range of 500 yards; some interpolation is necessary, therefore, pending an update of the diagrams.

4. Fig 1 illustrates firing zones, with g contours, at various target and fighter speeds for a height of 10,000 feet at elevation angles of $+5^\circ$ and $+10^\circ$. The illustrations show that the g required to track increases as range decreases. The firing range is pegged at 500 yards. This is consistent with the fixed gyro sensitivity of 0.65 seconds. Firing with angle-off at longer ranges results in too little lead; shorter ranges give too much lead. These errors are swamped, however, by other errors, such as gun line wander, for range errors of the order of ± 100 yards. The fixed gravity drop term also gives errors at ranges other than 500 yards but this is compensated for by the parallax errors, due to the gun line being 9 feet 5 inches below the sight line and working in the opposite sense.

5. Fig 2 shows two sets of relative trajectories for a 900 feet/second (approximately 0.9M) fighter attacking a 600 feet/second and 800 feet/second target respectively. Against the target at the lower speed, ie at the higher speed ratio, it is possible to achieve a moderate angle-off at firing range. However, the

level of g required is of the order of $5g$ throughout the attack. As the target speed increases, the obtainable angle-off decreases until at a target speed of 800 feet/second, it is virtually impossible to have any angle-off at firing range.

6. Fig 3 illustrates some typical bullet patterns for certain attack conditions against a non-maneuvring target, assuming steady tracking. The probable bullet pattern is based on the following assumptions:

- a. Gun line wander of 16 mils.
- b. Pilot tracking error of 10 mils.
- c. Bullet dispersion of 4 mils.

These give approximate bullet patterns of 20 feet radius at 333 yards range, 30 feet radius at 500 yards and 40 feet radius at 666 yards. The illustration demonstrates that aim-off must be allowed if the guns are fired at ranges other than that for which the sight is computing. Generally, lead angle should be increased and line should be high at ranges greater than 375 yards and lead angle should be decreased

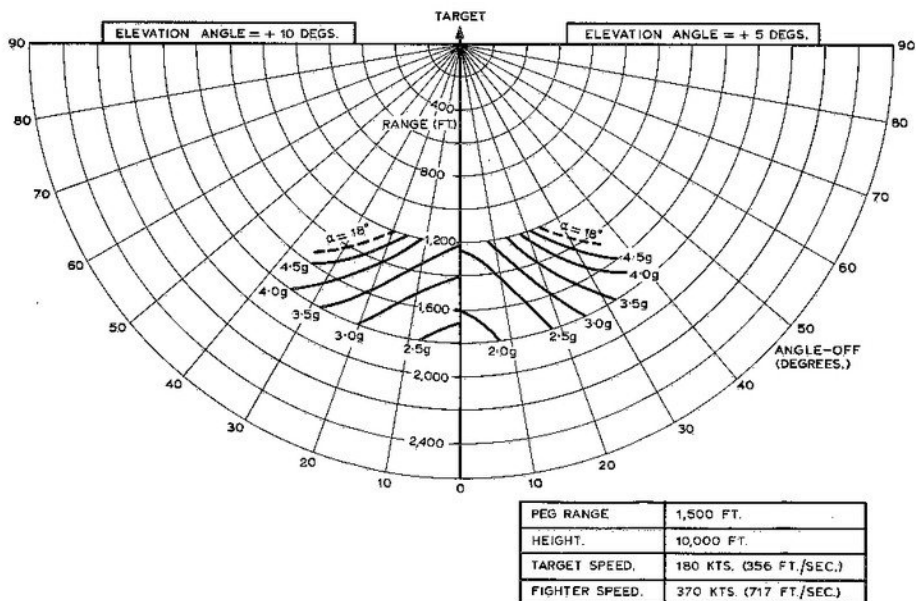
at ranges less than 375 yards. Where the target is manoeuvring, the optimum firing range is reduced and the effective range bracket is shortened; therefore, it is even more important in these conditions to fire at, or as close as possible to, the optimum range.

Guns Radar Ranging

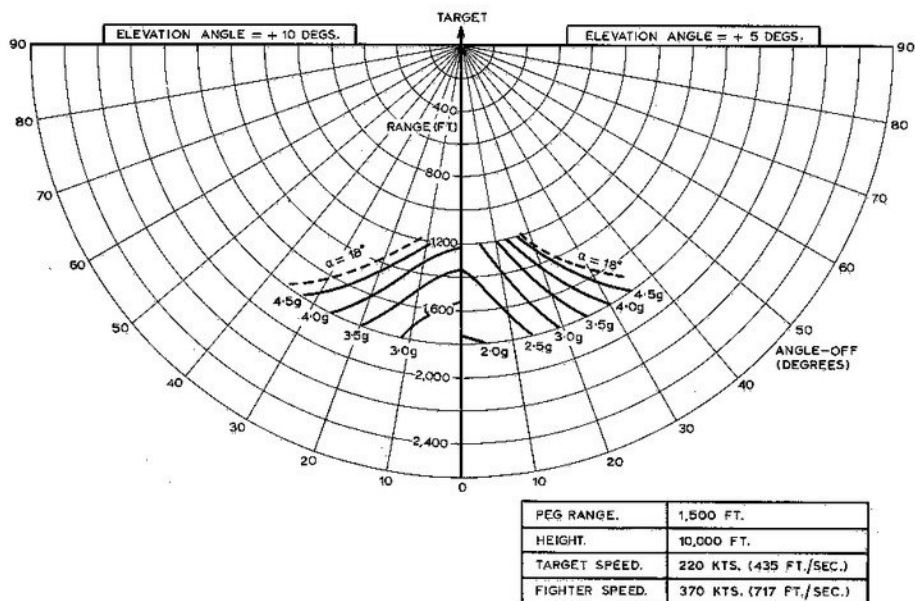
7. When in LFS and GUNS, the 'in-range' light on the LFS illuminates whenever a target is seen between 450 yards and 170 yards. ▶

Guns Pure Pursuit (GPP)

8. Guns Pure Pursuit (GPP) is obtained by selecting the MAS to GUNS with the radar in the track mode. The steering dot gives pure pursuit in azimuth but is raised 2.2° in elevation. This is made up of 1.9° difference between the missile line and the gun line, and 0.3° (approximately) of gravity drop at 500 yards. GPP may be used by selecting vis-ident and tracking the steering dot at 500 yards from exactly line astern.

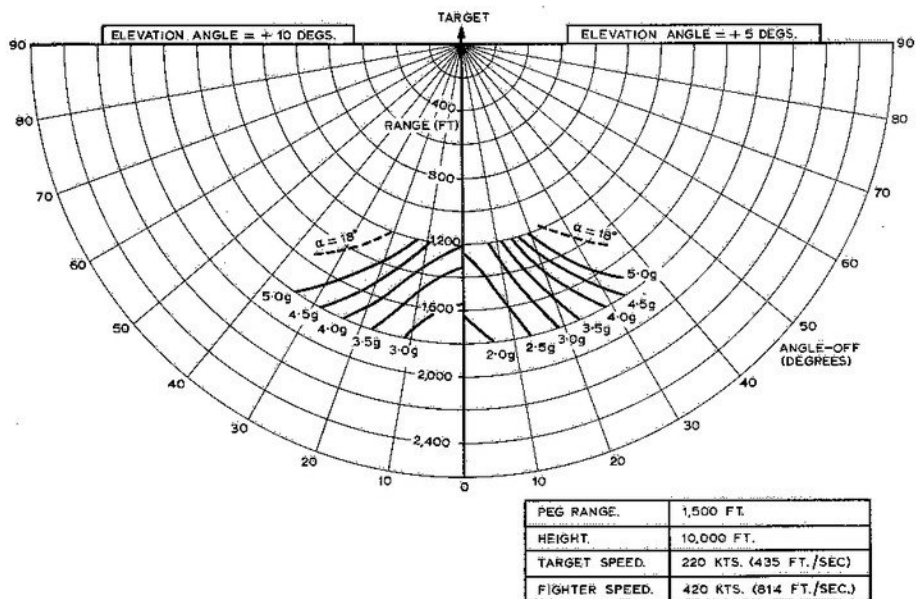


1-8-3 Fig.1 Firing Zones (1)



1-8-3 Fig.1 Firing Zones (2)

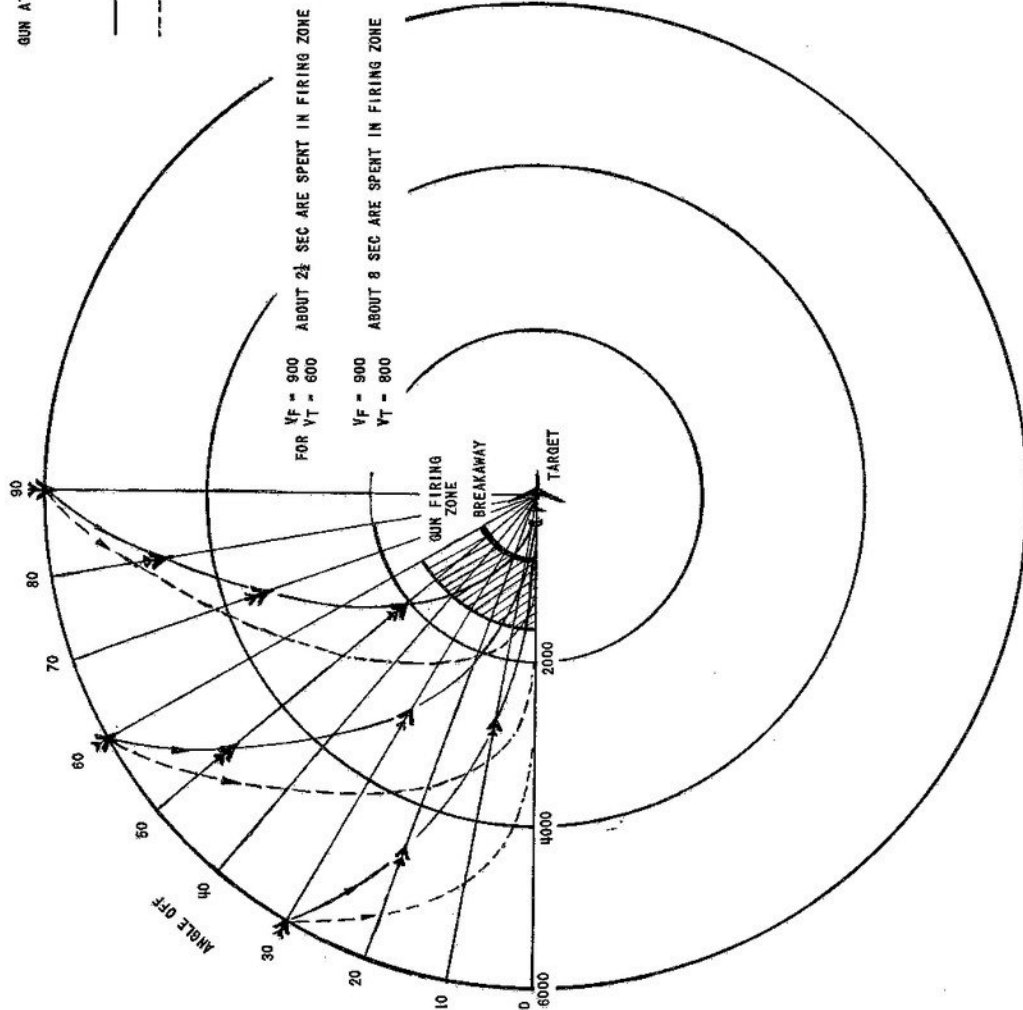
RESTRICTED



1-8-3 Fig. 1 Firing Zones (3)

GUN ATTACKS WITH LEAD PREDICTION

$V_F = 900$ FT/SEC
 $V_T = 600$ FT/SEC
 $V_T = 800$ FT/SEC

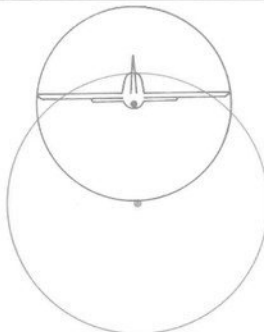


1-8-3 Fig. 2 Relative Plot of Fighter Trajectory with Respect to Target

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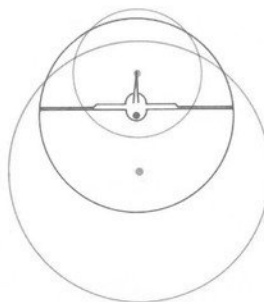
FIGHTER SPEED: 900 FT./SEC.
 TARGET: 800 FT./SEC. NON-MANOEUVRING, WING SPAN 60 FEET
 ALTITUDE: SEA LEVEL TO 20,000 FT APPROX.

ANGLE - OFF
 0° AZIMUTH
 +10° ELEVATION



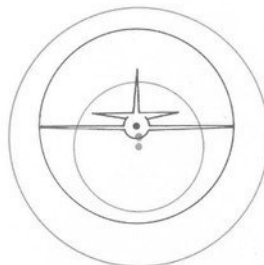
0° BANK ANGLE
 4 G APPROX

ANGLE - OFF
 0° AZIMUTH
 +5° ELEVATION



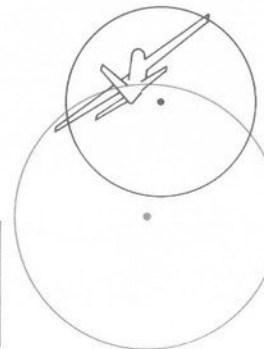
0° BANK ANGLE
 2 TO 4 G

ANGLE - OFF
 0° AZIMUTH
 0° ELEVATION



0° BANK ANGLE
 0.7 TO 1.5 G

ANGLE - OFF
 10° AZIMUTH
 +10° ELEVATION

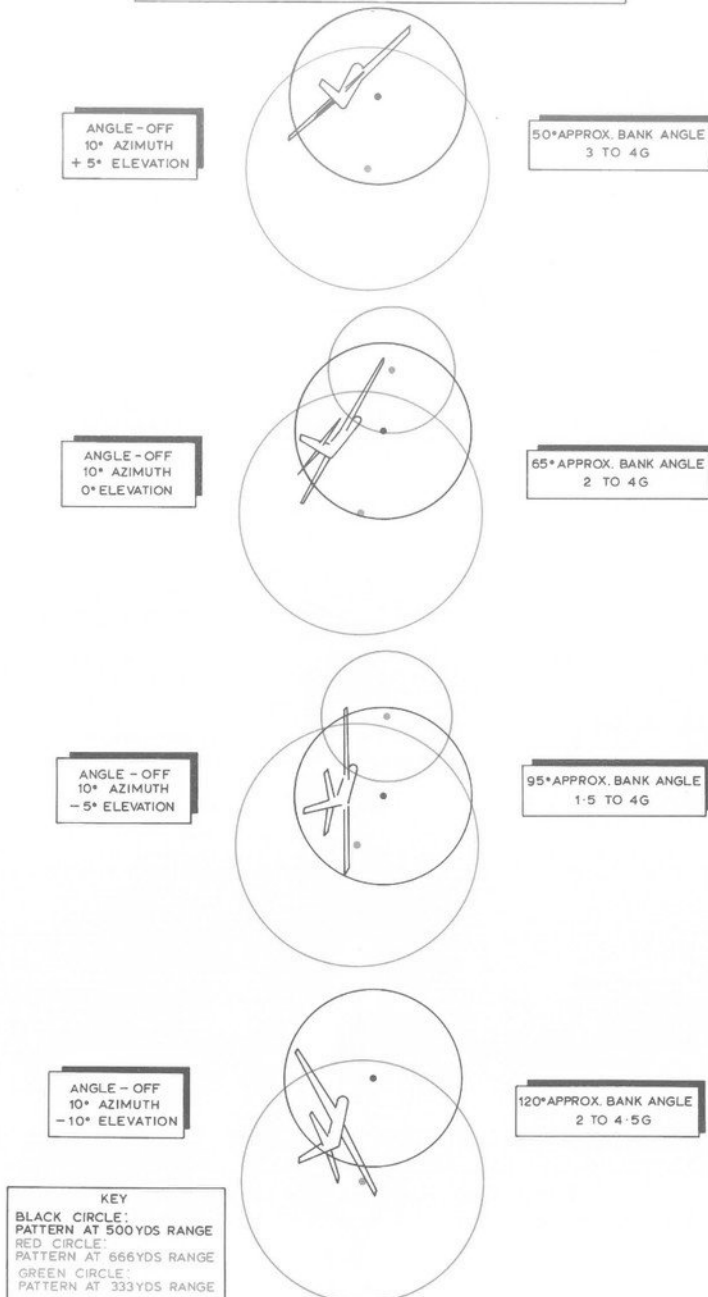


35° APPROX. BANK ANGLE
 4 G

KEY
 BLACK CIRCLE:
 PATTERN AT 500 YDS RANGE
 RED CIRCLE:
 PATTERN AT 666 YDS RANGE
 GREEN CIRCLE:
 PATTERN AT 333 YDS RANGE

1—8—3 Fig. 3 Typical Bullet Patterns (1)

FIGHTER SPEED: 900 FT./SEC.
TARGET: 800 FT./SEC. NON-MANOEUVRING, WING SPAN 60 FEET
ALTITUDE: SEA LEVEL TO 20,000 FT. APPROX.



1-8-3 Fig. 3 Typical Bullet Patterns (2)

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