PART 3 CLIMB

Two configurations (A) with 250-gal ventral tank
(B) with 250-gal ventral tank and two Red Tops

LIST OF FIGURES ◀ (F Mk.3 aircraft - white leaves) ▶

◀ LIST OF FIGURES (T Mk.5 aircraft - coloured leaves)

With reheat

Climbs at constant attitude (roller blind)

1. Presentation

Because of the amount of fuel used, the climb phase may be of considerable importance in planning. The time, distance, and fuel vary widely with atmospheric temperature, and data are given over a temperature range of ICAO ± 20°C.

In order that any atmosphere likely to be met in practice is covered *(tropopause between 25,000 ft and 39,000 ft)*, the climb has been divided into two parts. The first applies to atmospheres up to 40,000 ft with the ICAO lapse rate, the second covers isothermal atmospheres from 25,000 ft to 45,000 ft. The total time, distance, and fuel is found by the addition of the two parts.

Example (A)

Climb from SL to 36,000 ft in ICAO atmosphere at 450 kts/0.87M with ventral tank, without reheat, take-off weight = 34,400 lb.

From Fig. 3.1
Acceleration to 450 kts takes 0.95 min, uses 755 lb fuel, and covers 2.8 anm.

From Fig. 3.2, 3.3, & 3.4 for aircraft with ventral tank. Climb to 36,000 ft takes 2.75 min, uses 730 lb fuel, and covers 23 anm.

Therefore the total is
3.7 min, 1,485 lb fuel, 25.8 anm.

Example (B)

Take-off and climb from 6,000 ft to 44,000 ft with 250-gal ventral tank and two Red Tops, with reheat, take-off weight = 35,200 lb. Tropopause reported at -55°C at 32,000 ft *(this is ICAO-7°C in troposphere)*.

From Fig. 3.8
Acceleration to 450 kts takes 0.8 min, uses 947 lb fuel, and covers 2.8 anm.

From Fig. 3.9, 3.10, 3.11 for aircraft with 250-gal ventral tank and two Red Tops.

Climb from 6,000 ft to 32,000 ft takes *(1.35 - 0.2)* = 1.15 min, uses *(930-220)* = 710 lb fuel, and covers *(9.9-2.8)* = 7.1 anm.

From Fig. 3.12, 3.13, 3.14 for aircraft with 250-gal ventral tank and two Red Tops.

Climb from 32,000 ft to 44,000 ft at -55°C takes *(1.85-0.4)* = 1.45 min, uses *(640-190)* = 450 lb fuel, and covers *(15-3)* = 12 anm.

Therefore the total is
3.4 min, 2,107 lb fuel, and 21.9 anm

Example (C)

Ground level temperature may not correspond to the troposphere temperatures as defined by the tropopause. In this case the ground level performance would be altered slightly. Thus, if in Example (B) the measured ground level temperature were 10°C, then the acceleration to 450 kts *(Fig. 3.8)* would take

0.8 min, use 960 lb fuel, and cover 2.9 anm.

The two climb phases would not be altered significantly.

Therefore the total is
3.4 min, 2,120 lb fuel, and 22 anm.

Example (D)

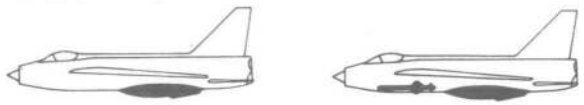
Climb at θ = 20° from 50,000 ft to 65,000 ft, initial Mach No. 1.5.

Fig. 3.24 gives:-

time taken to climb = 1.05 min
distance covered on climb = 12.5 anm

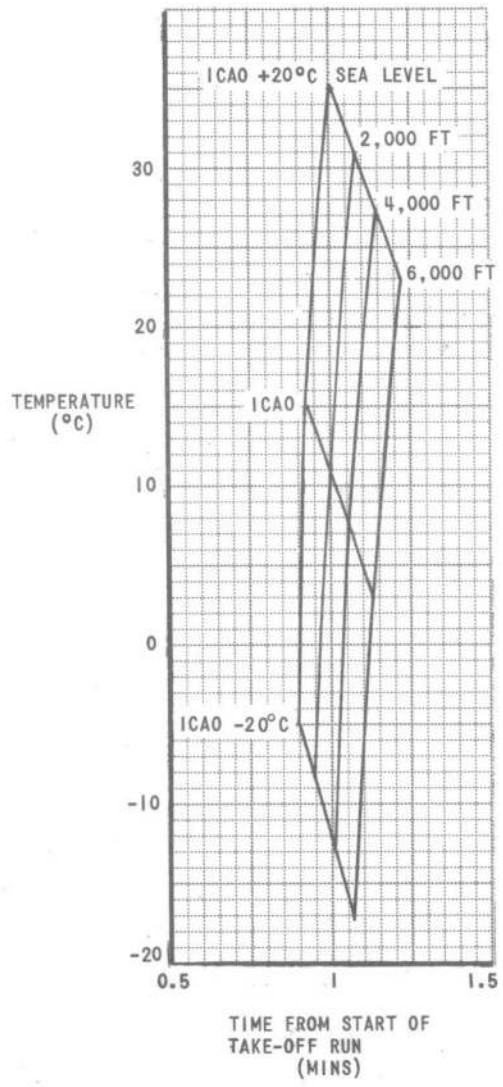
Fig. 3.25 gives:-

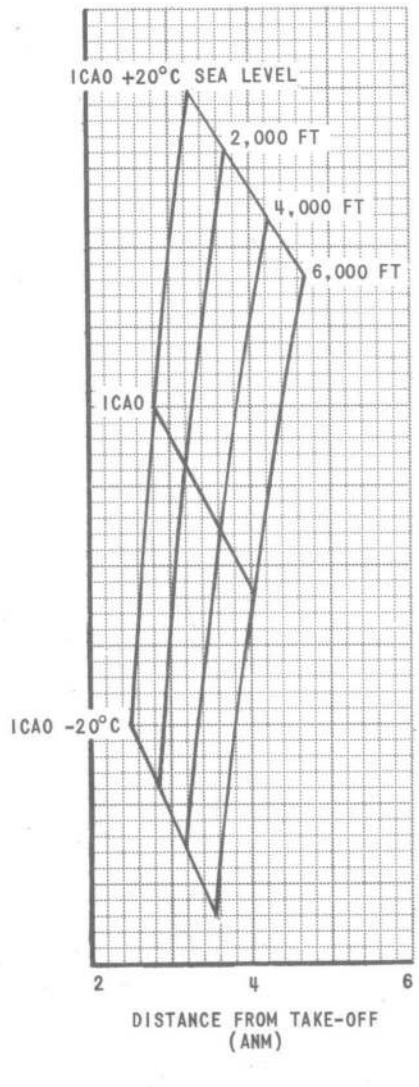
fuel used during climb = 195 lb
final Mach No. = 1.02



FUEL ALLOWANCES:
START-UP AND TAXI 450 LB
TAKE OFF 110 LB

NO REHEAT





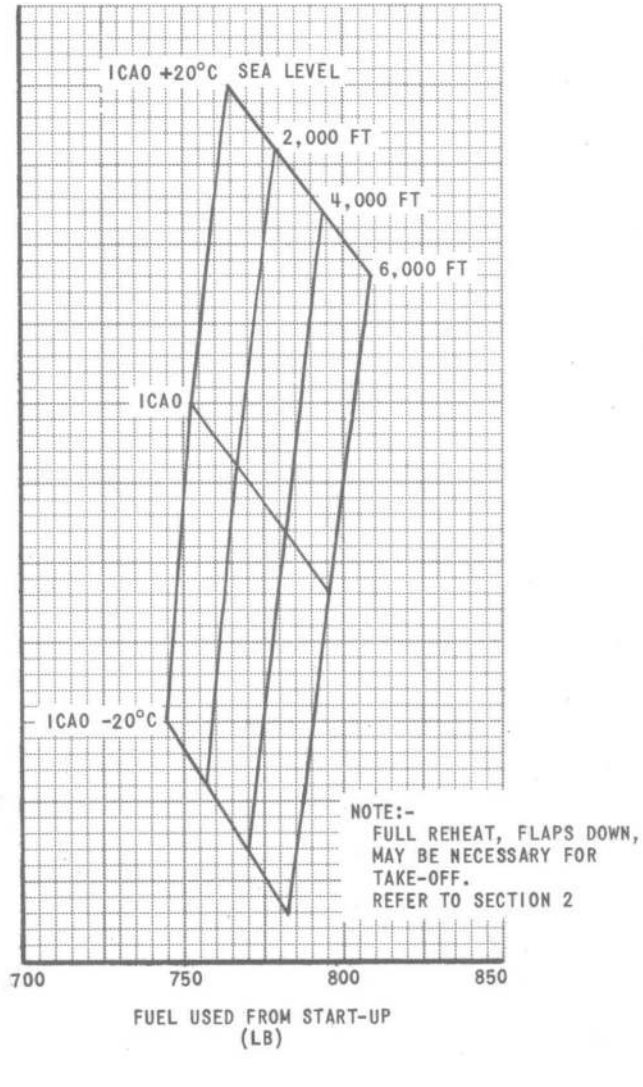


FIG.3.1. GROUND LEVEL ACCELERATION TO 450K IAS

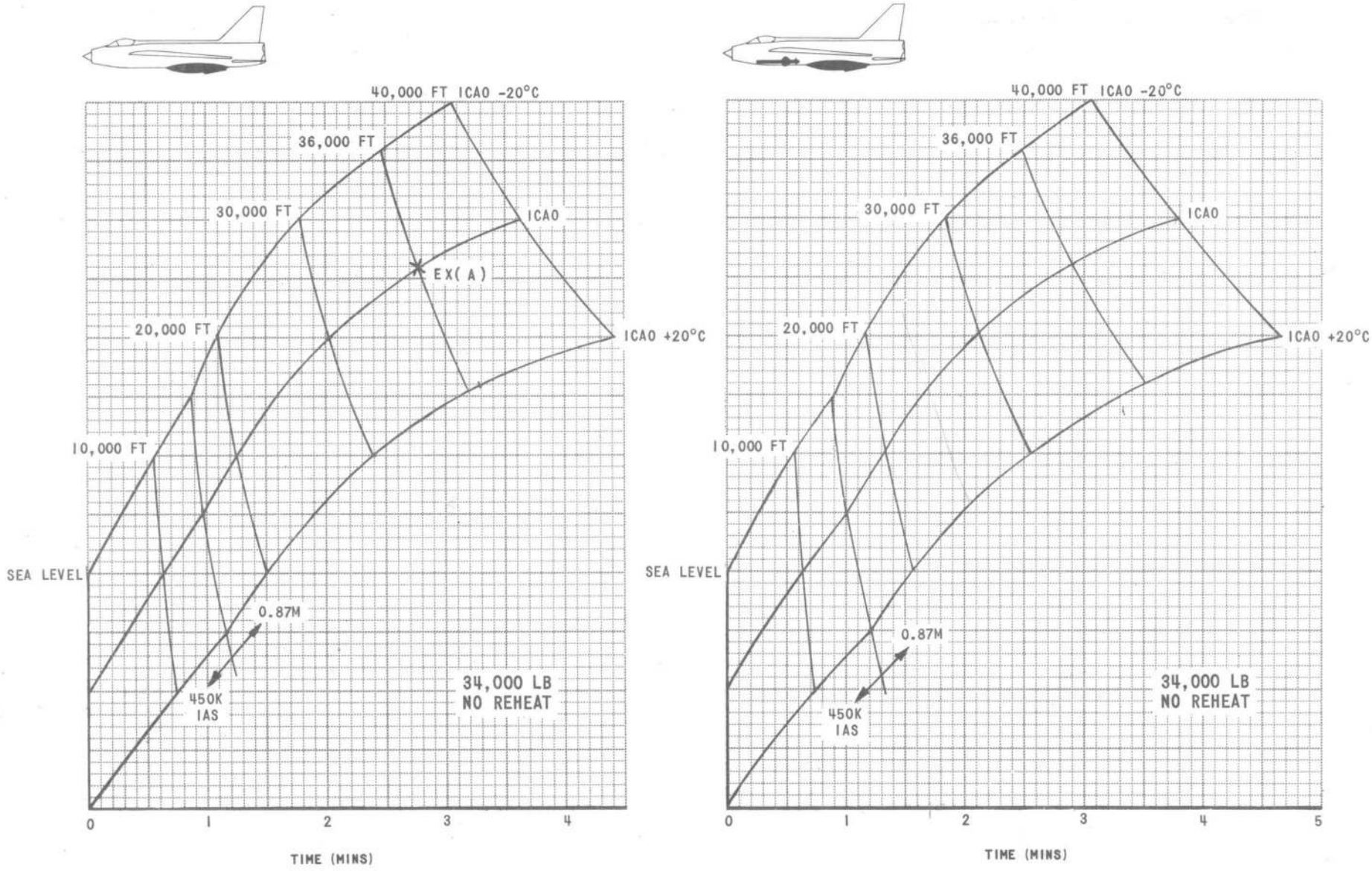


FIG.3.2. CLIMB AT 450K AND 0.87M IN TROPOSPHERE TIME TO ALTITUDE

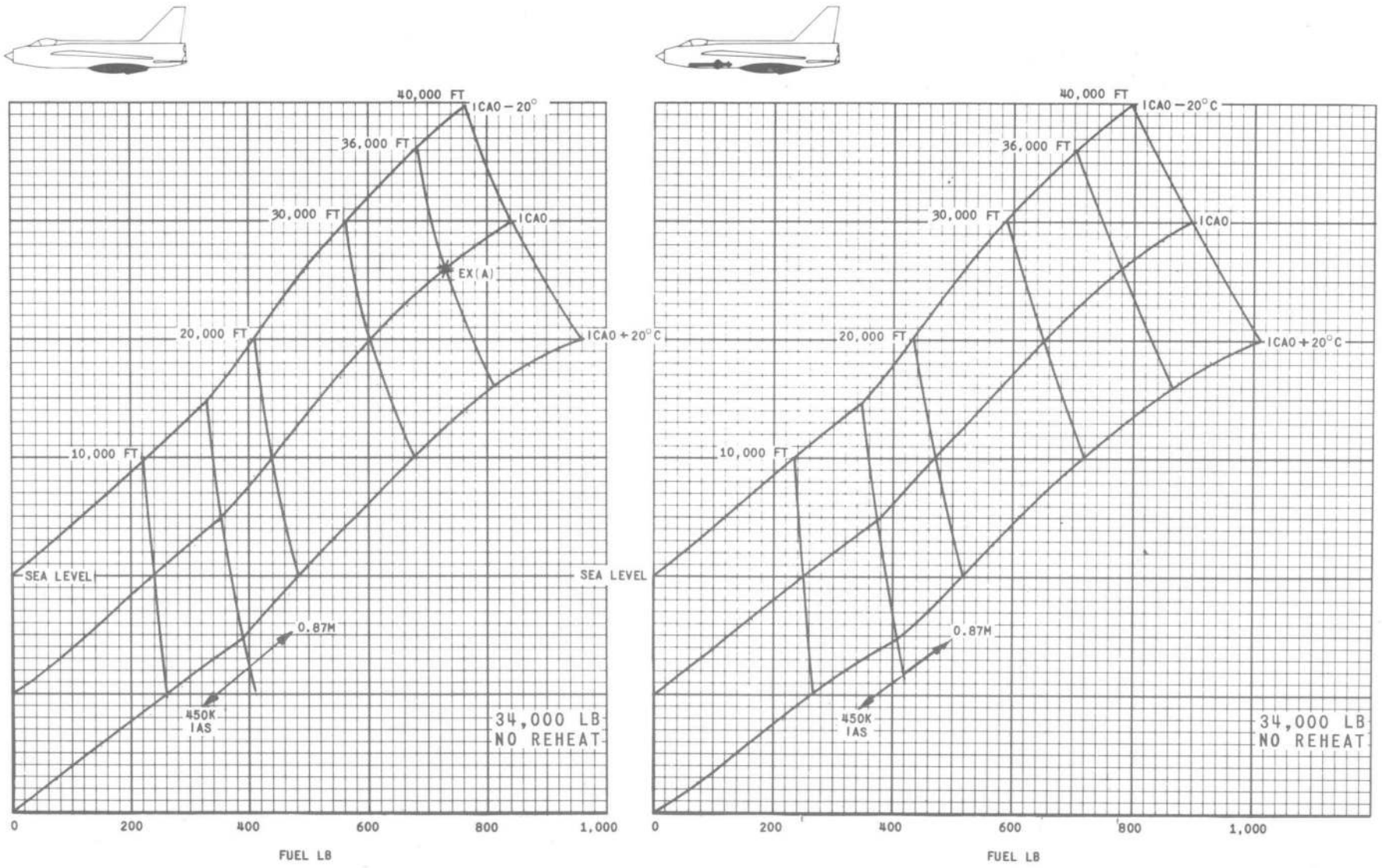


FIG. 3·3. CLIMB AT 450K AND 0·87M IN TROPOSPHERE FUEL TO ALTITUDE

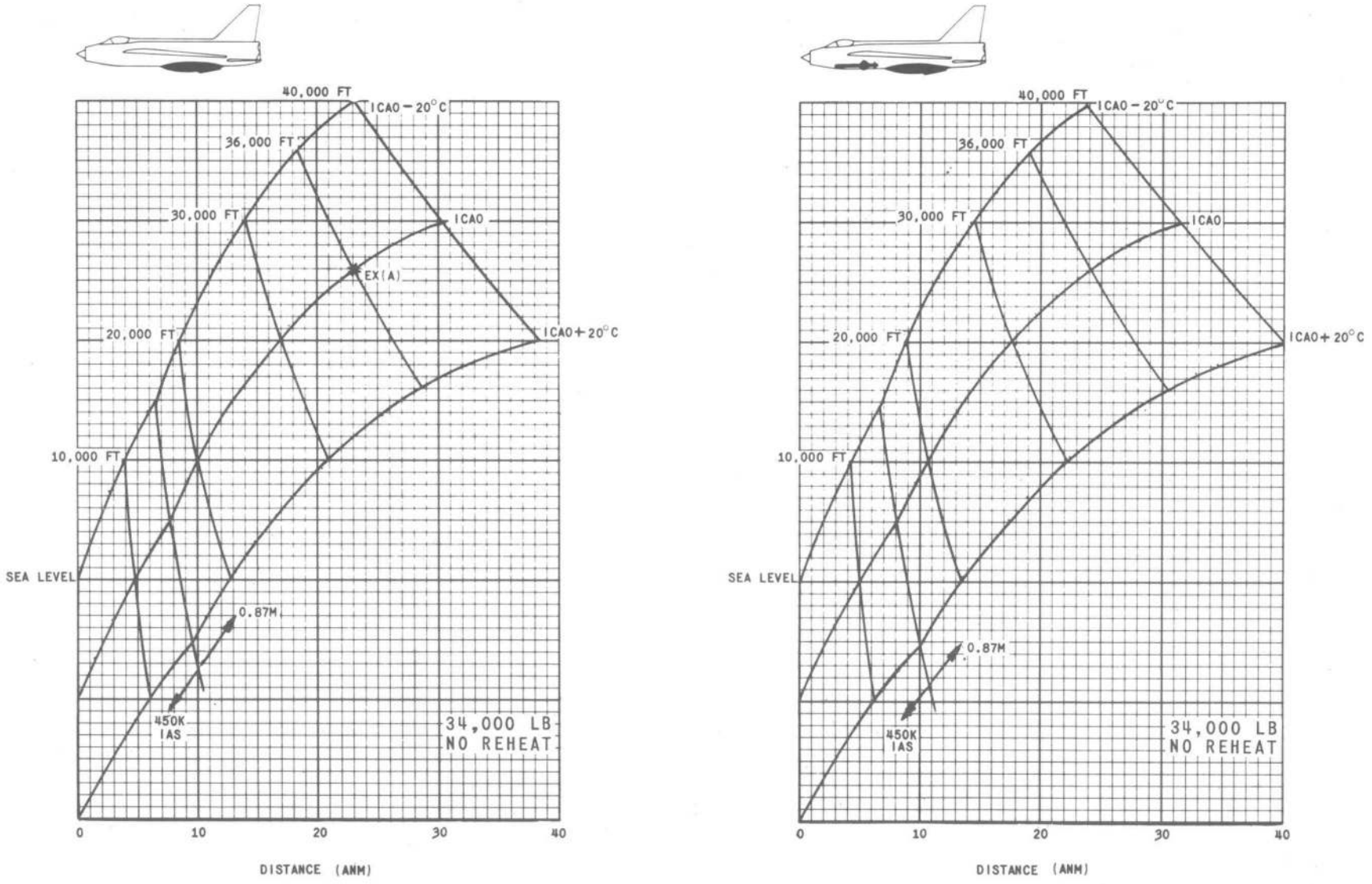


FIG. 3·4. CLIMB AT 450 K AND 0·87 M IN TROPOSPHERE DISTANCE TO ALTITUDE

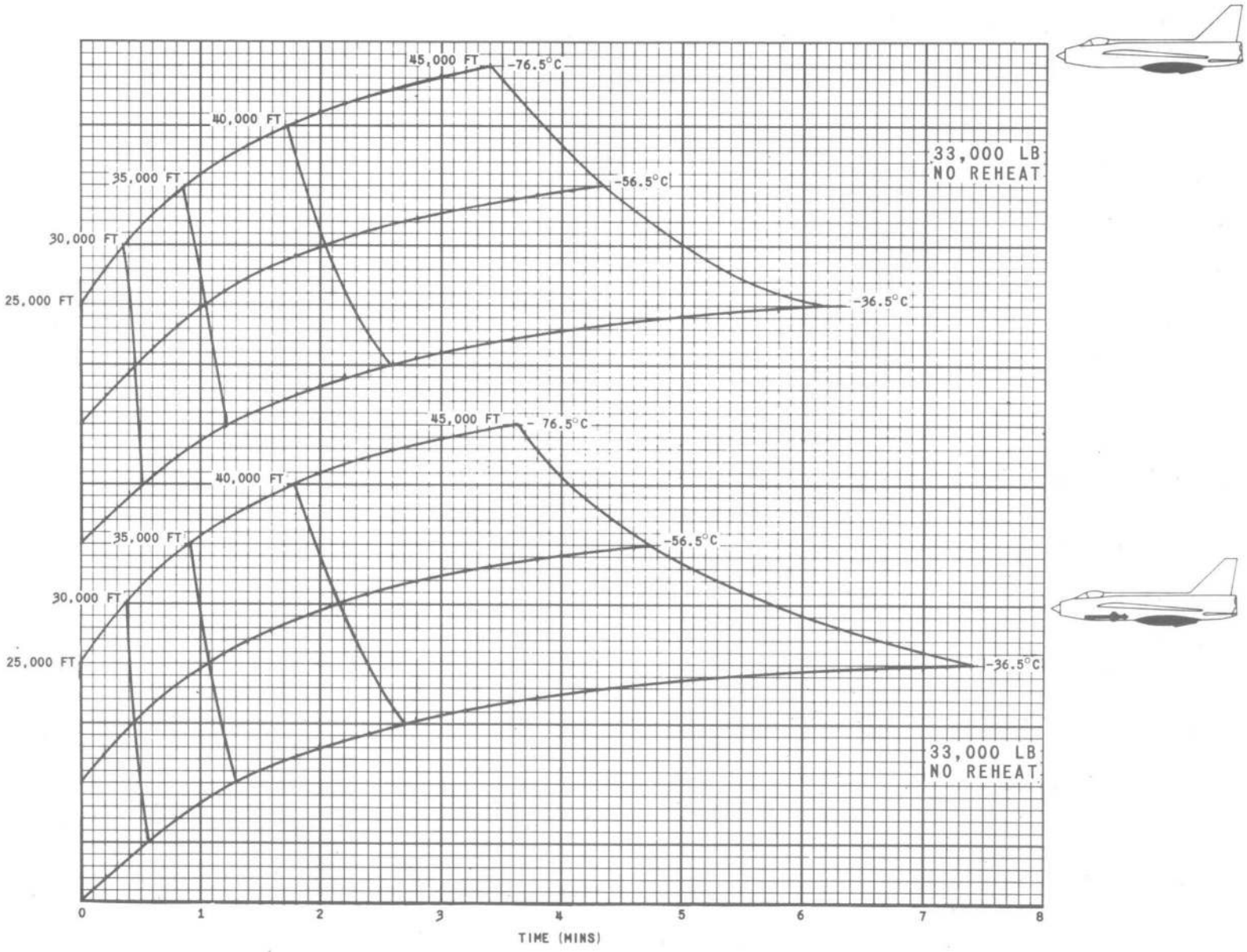


FIG. 3·5. CLIMB AT 0·87M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE

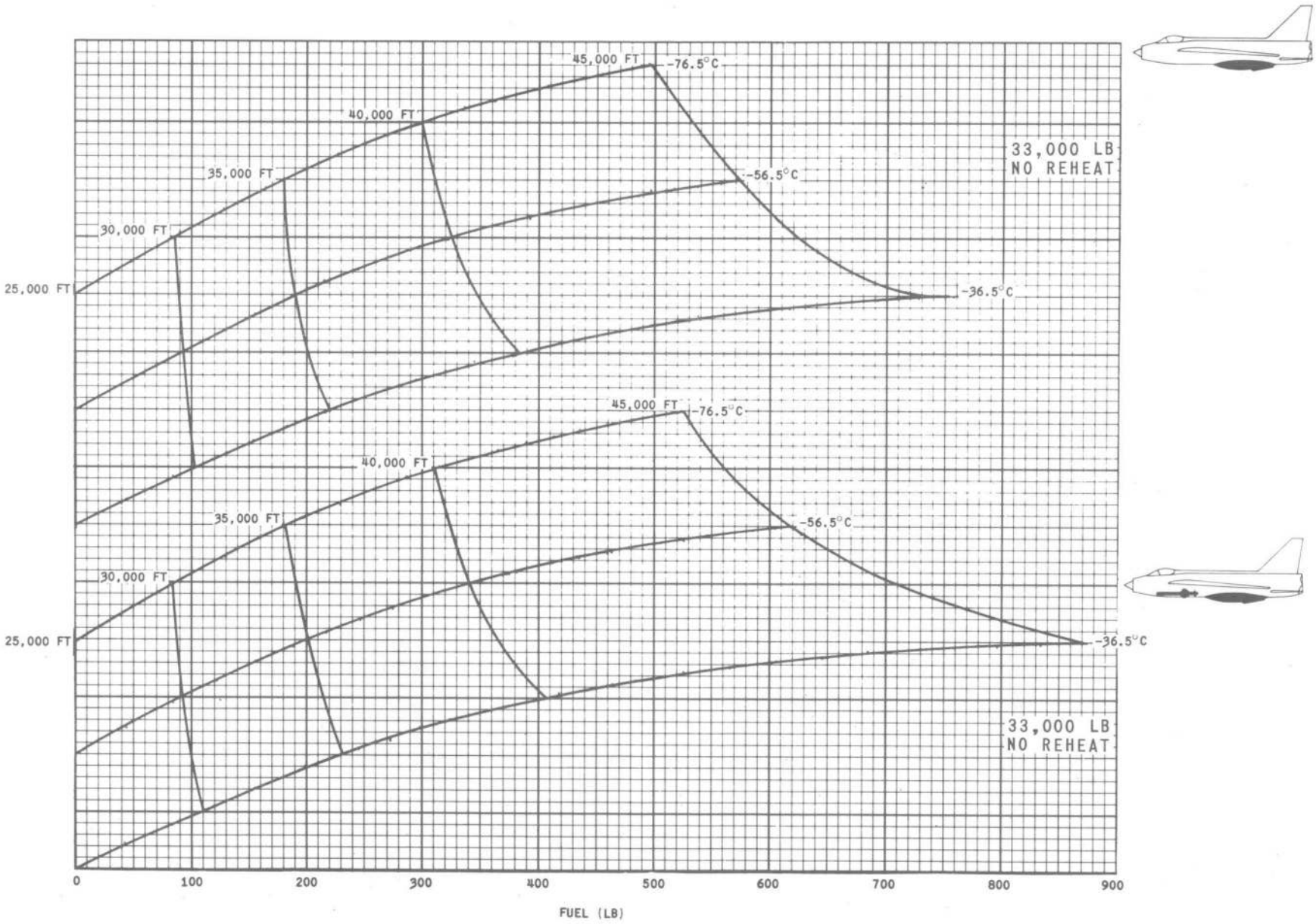


FIG. 3·6. CLIMB AT 0·87M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

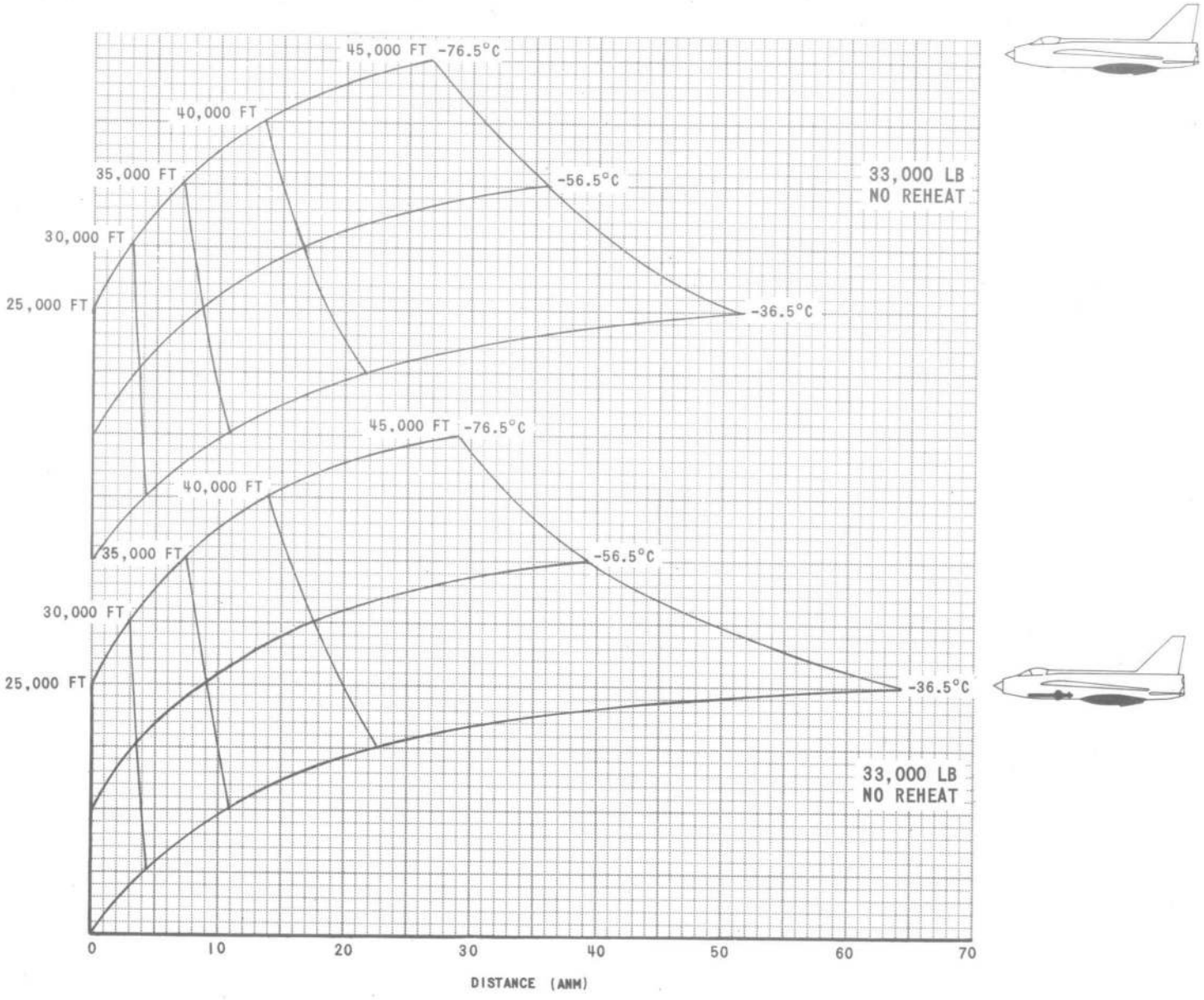
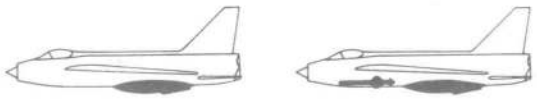
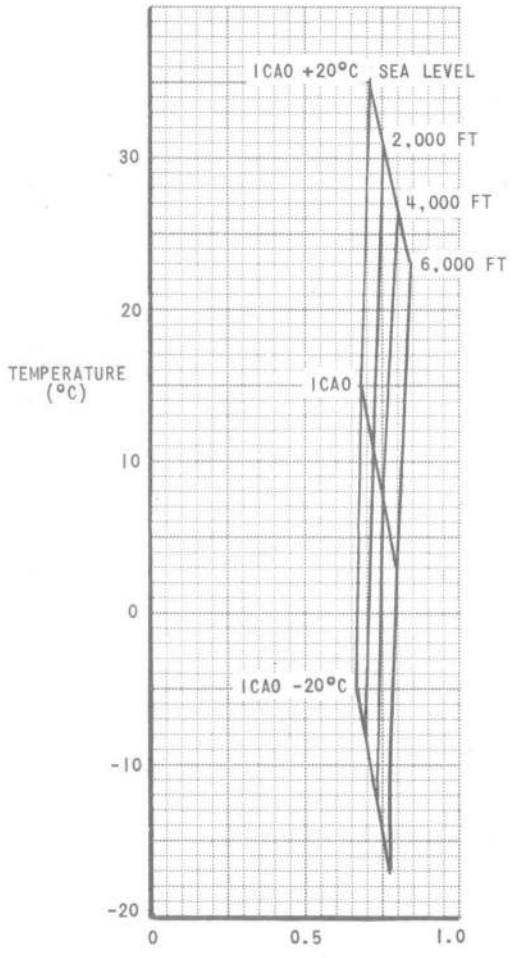


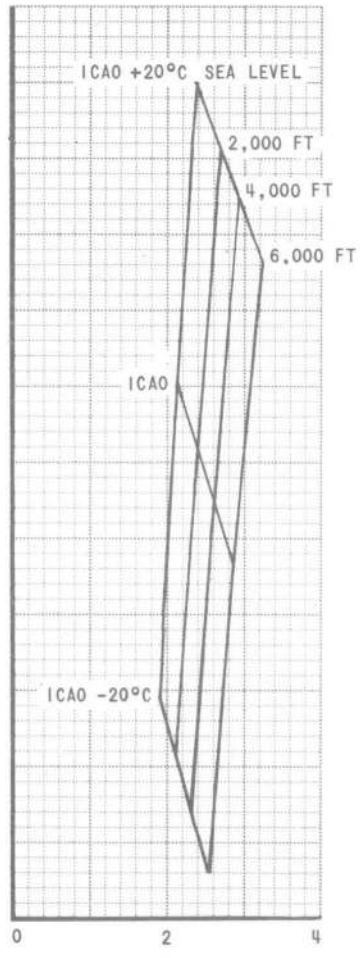
FIG. 3.7. CLIMB AT 0.87M IN ISOTHERMAL ATMOSPHERE DISTANCE TO ALTITUDE



REHEAT

FUEL ALLOWANCES:
START-UP AND TAXI 450 LB
TAKE OFF 210 LB





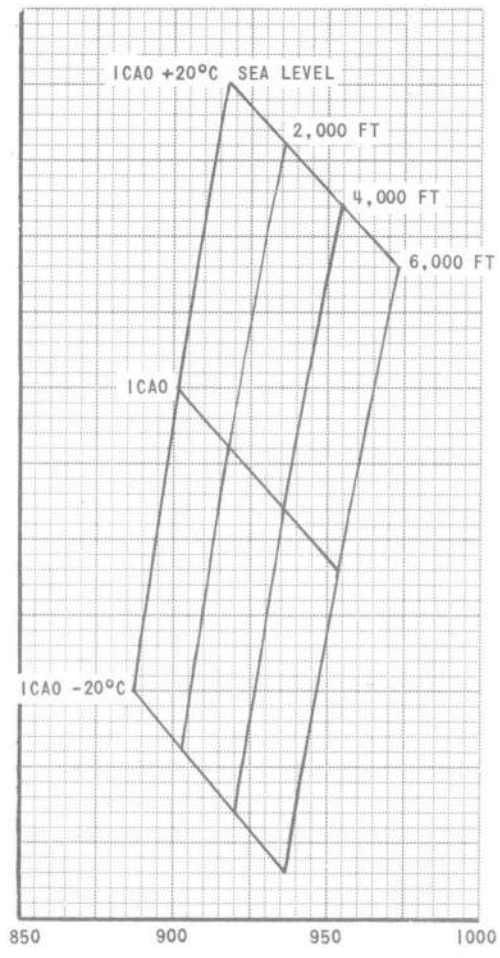


FIG.3.8. GROUND LEVEL ACCELERATION TO 450K IAS

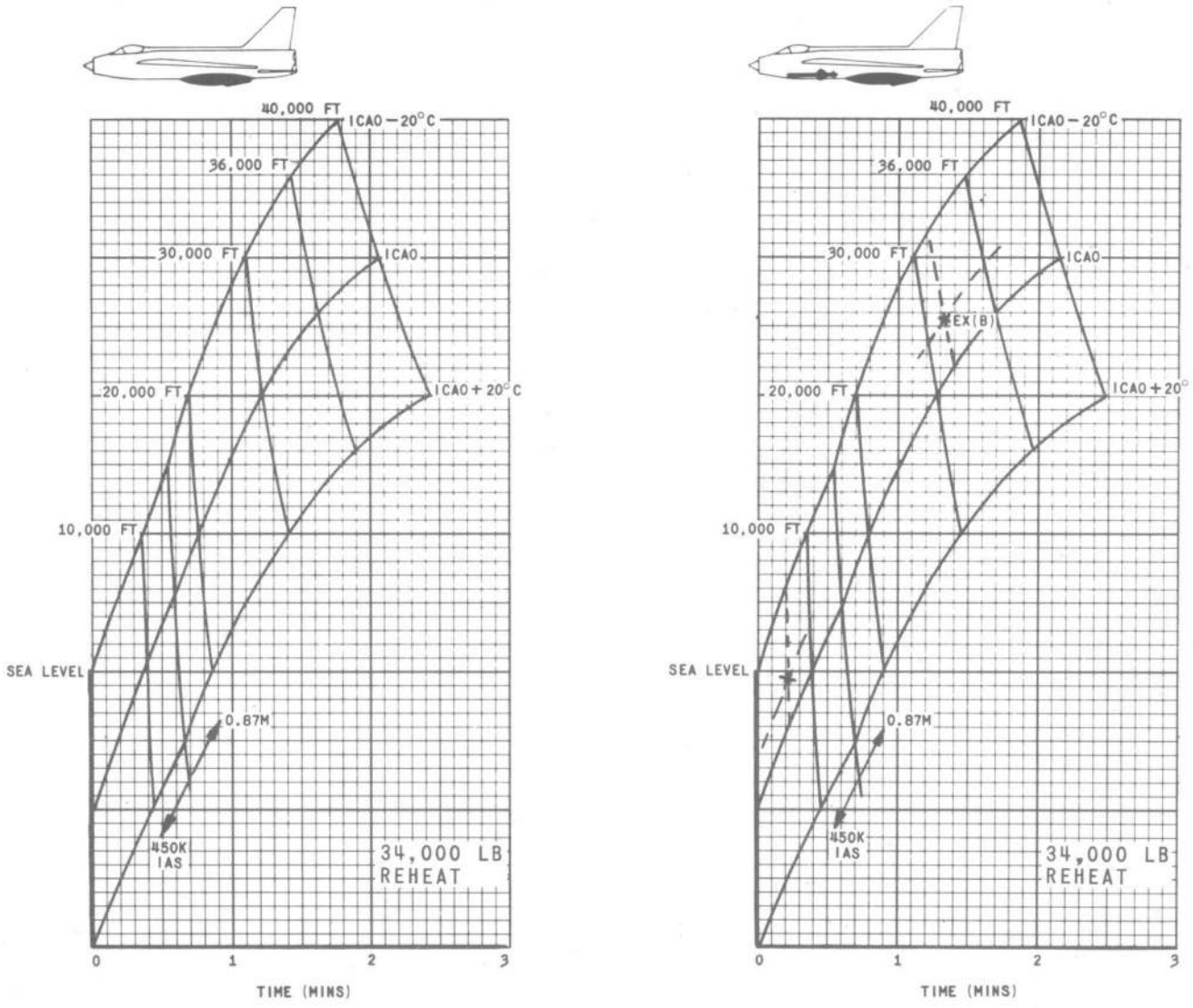
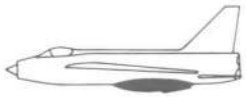


FIG. 3·9. CLIMB AT 450 K AND 0·87 M IN TROPOSPHERE TIME TO ALTITUDE



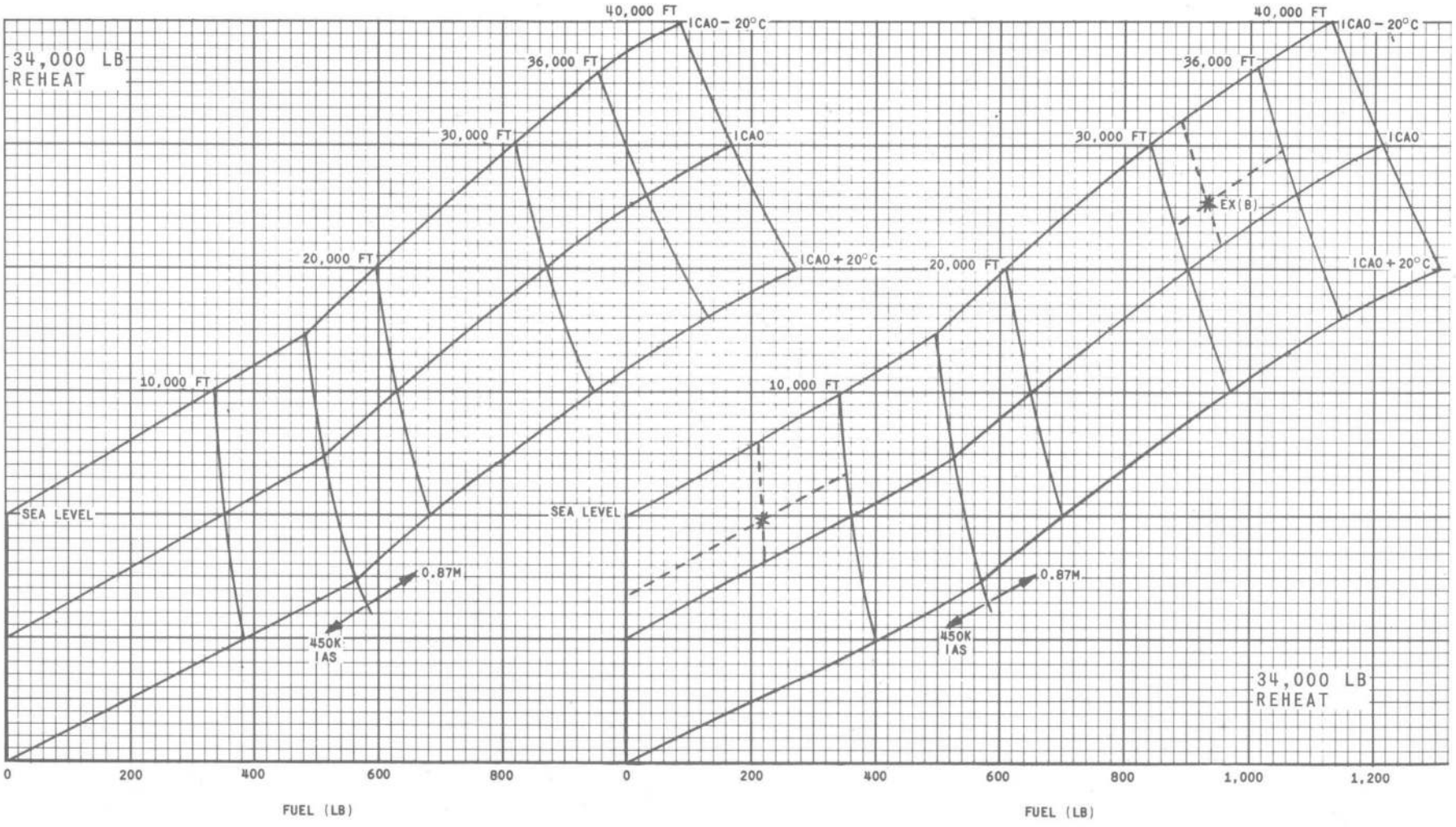
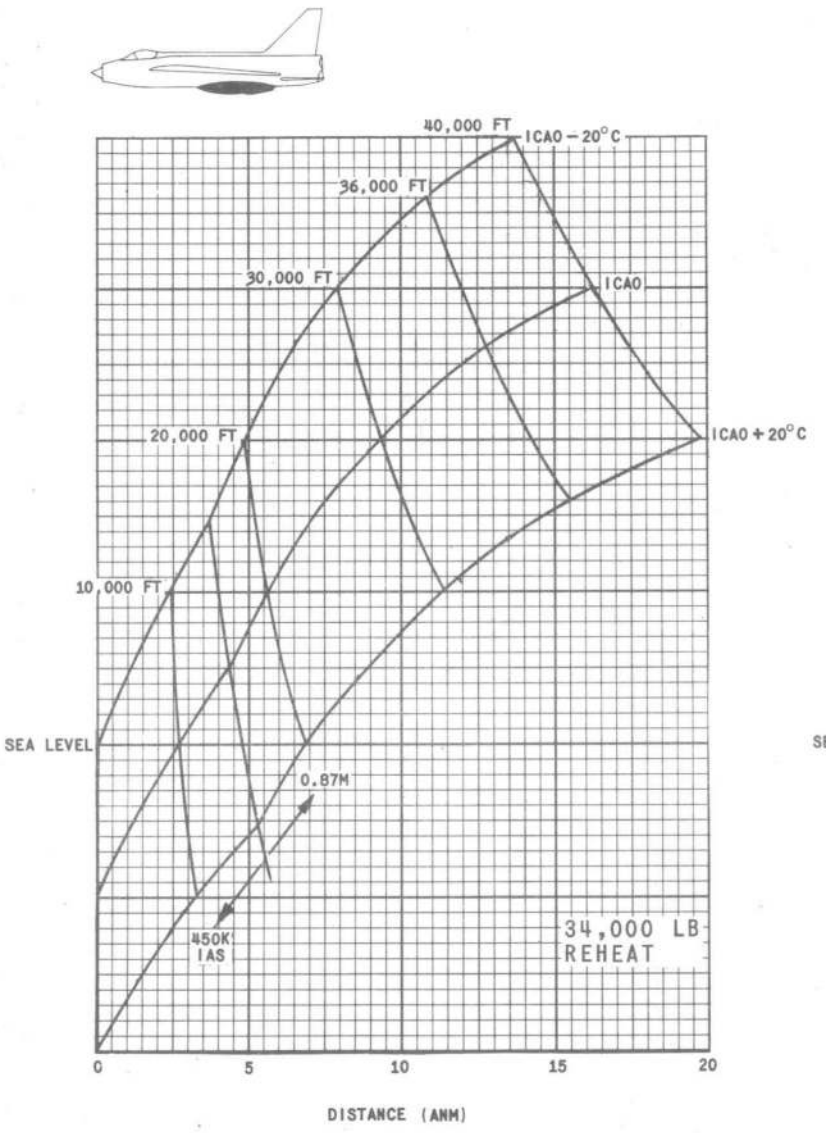


FIG. 3·10. CLIMB AT 450 K AND 0·87 M IN TROPOSPHERE FUEL TO ALTITUDE



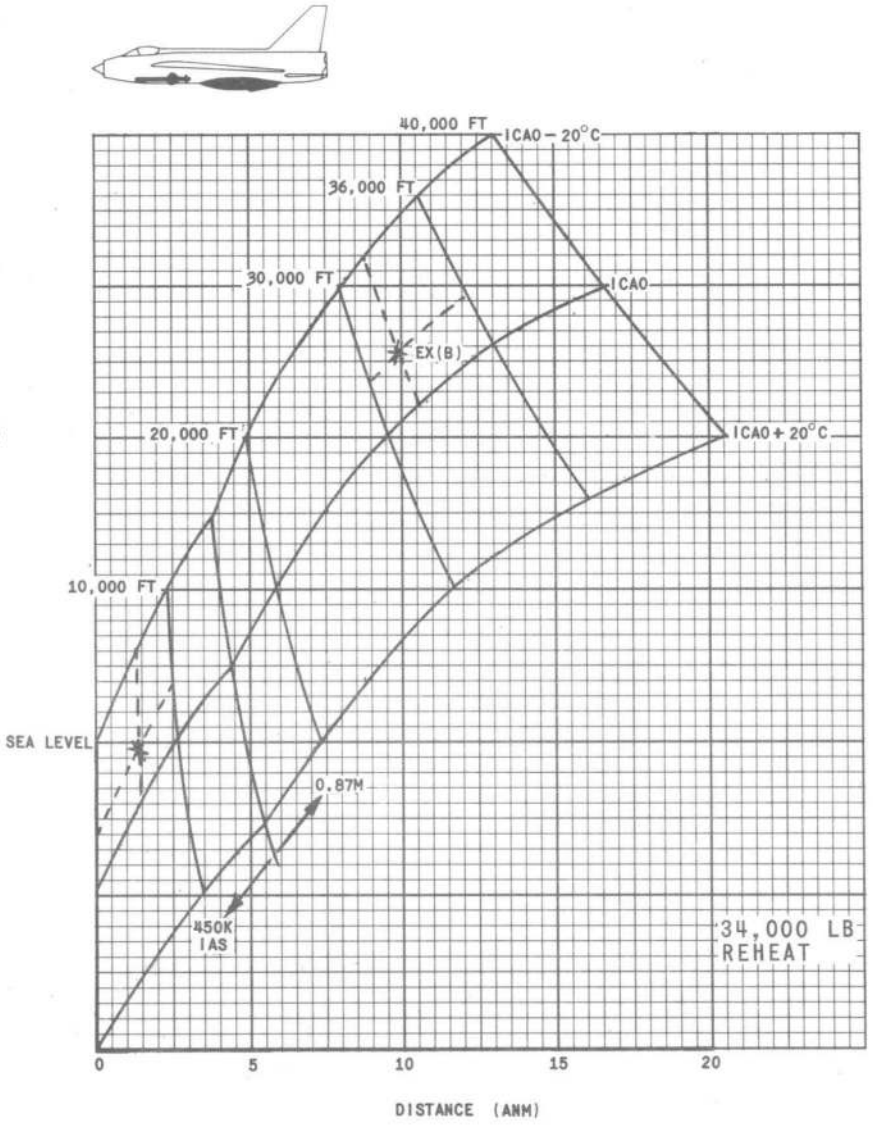


FIG. 3·11. CLIMB AT 450 K AND 0·87 M IN TROPOSPHERE DISTANCE TO ALTITUDE

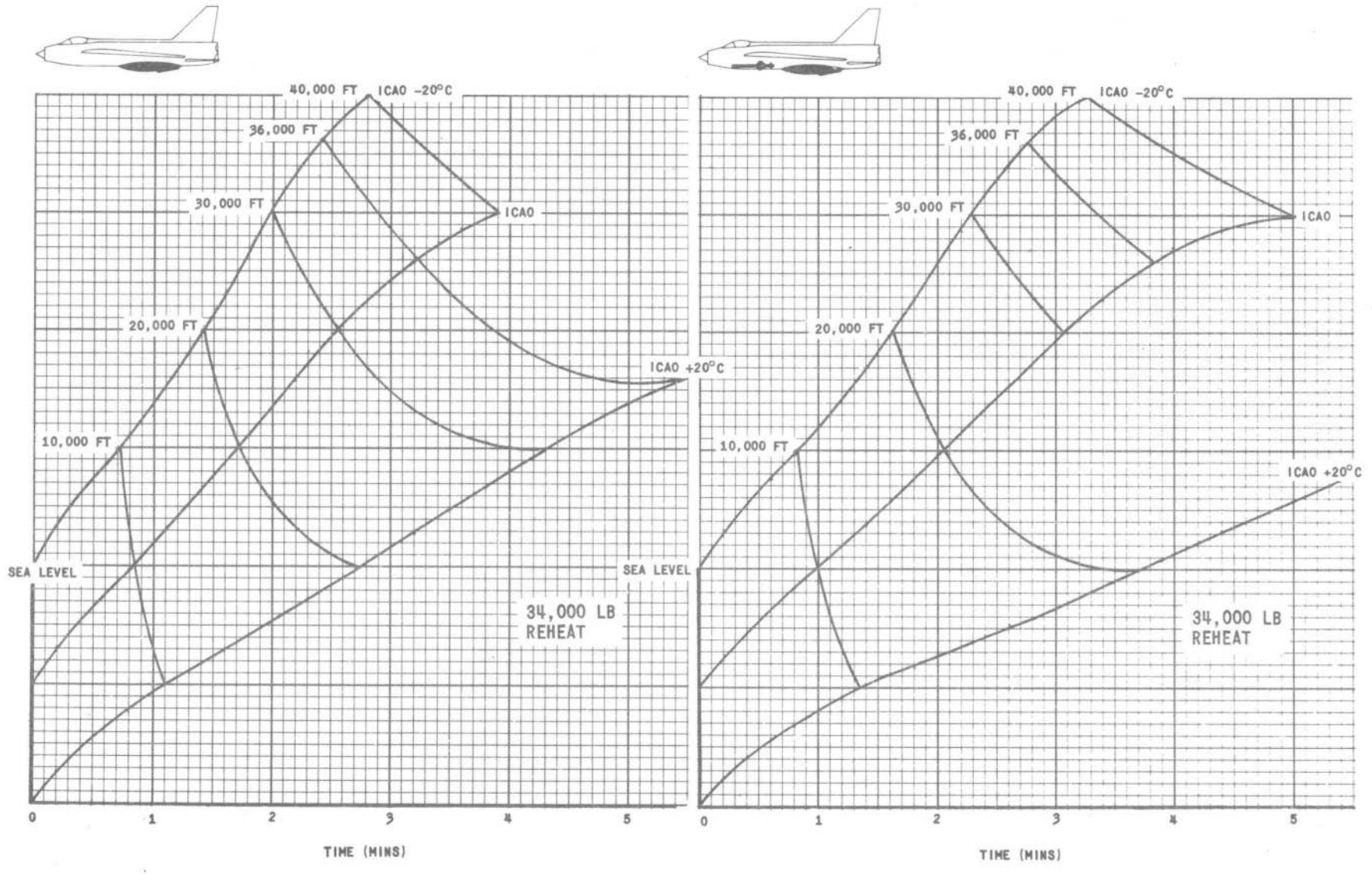


FIG.3.11/1. CLIMB AT 650K IN TROPOSPHERE TIME TO ALTITUDE

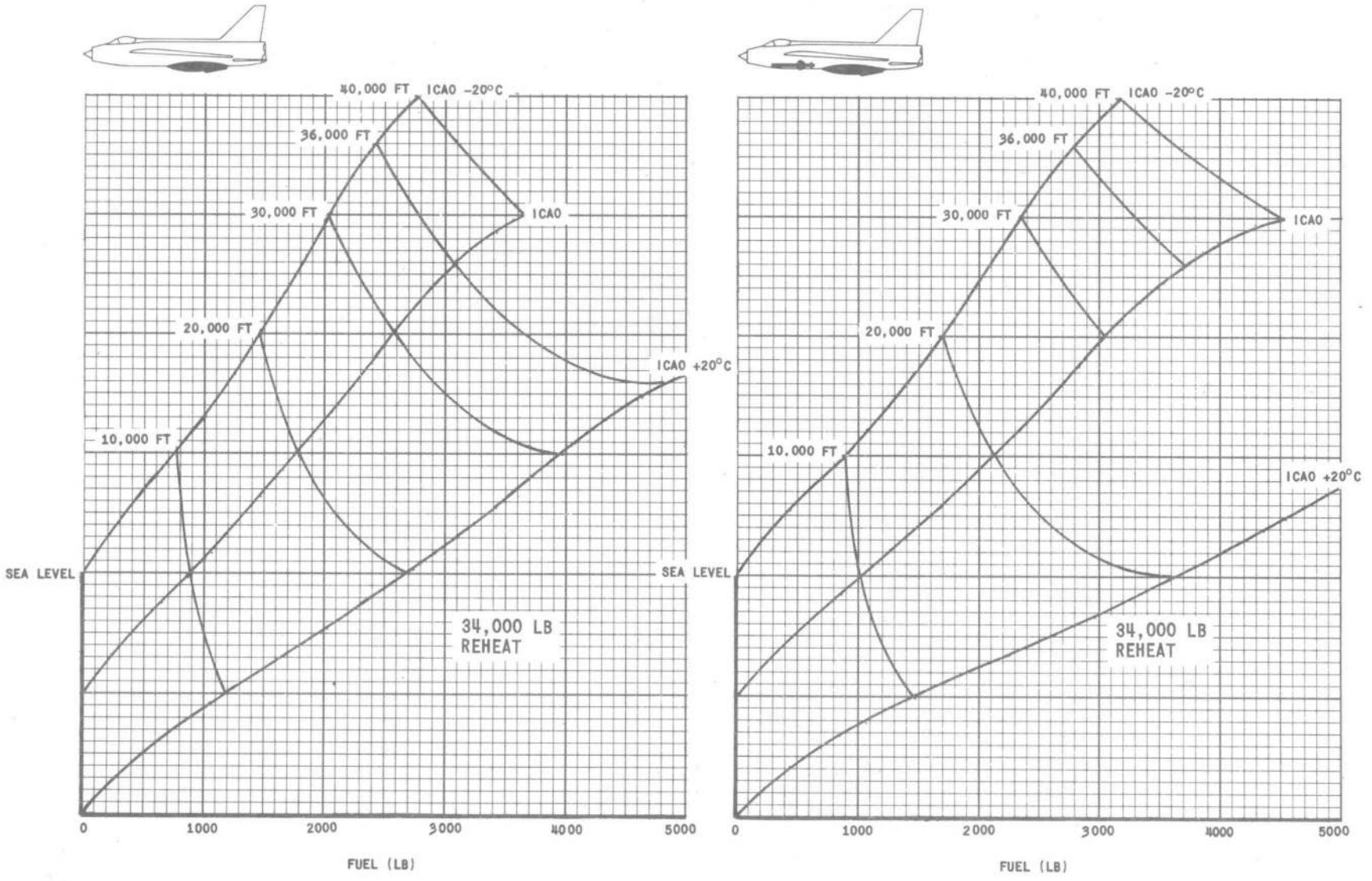
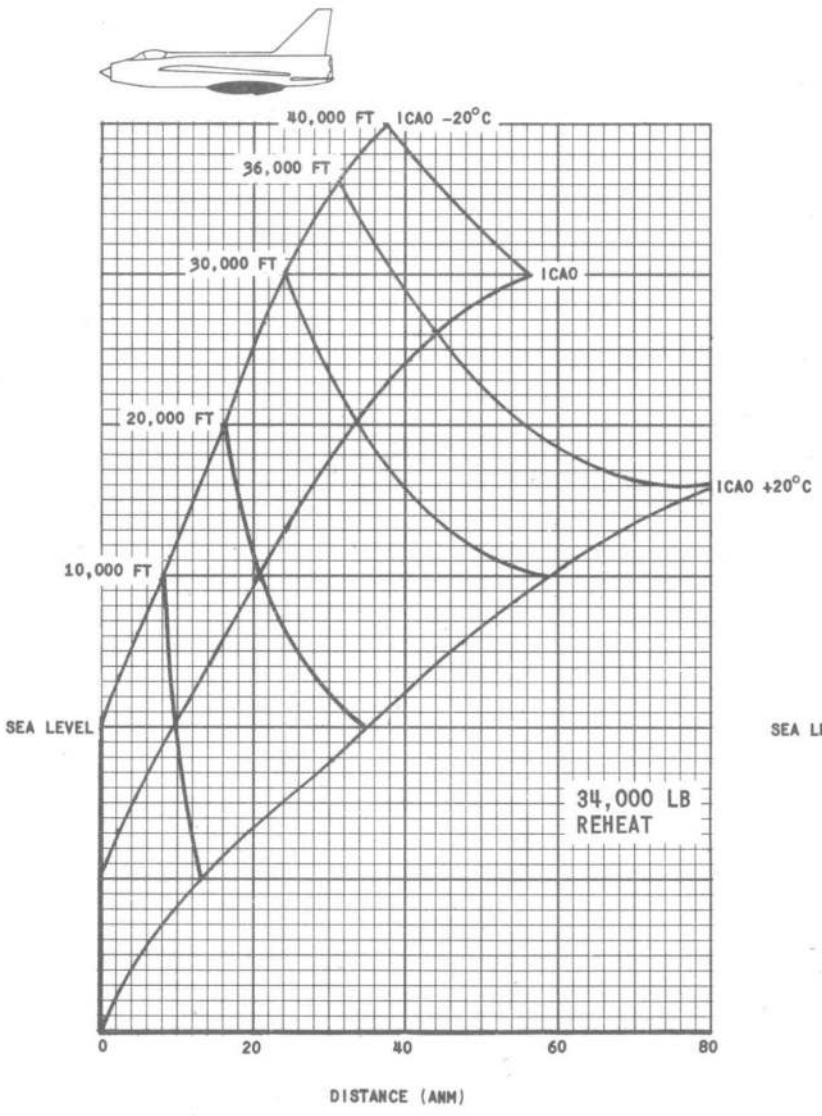


FIG.3.11/2. CLIMB AT 650K IN TROPOSPHERE FUEL TO ALTITUDE



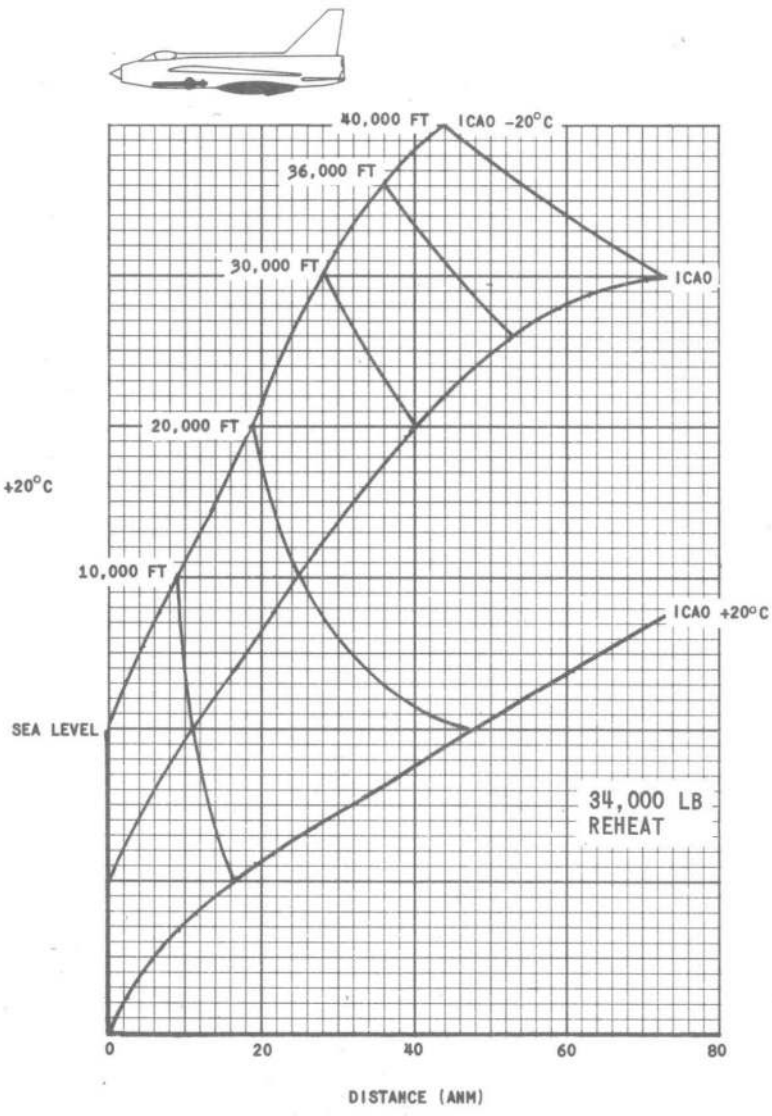


FIG.3.11/3. CLIMB AT 650K IN TROPOSPHERE DISTANCE TO ALTITUDE

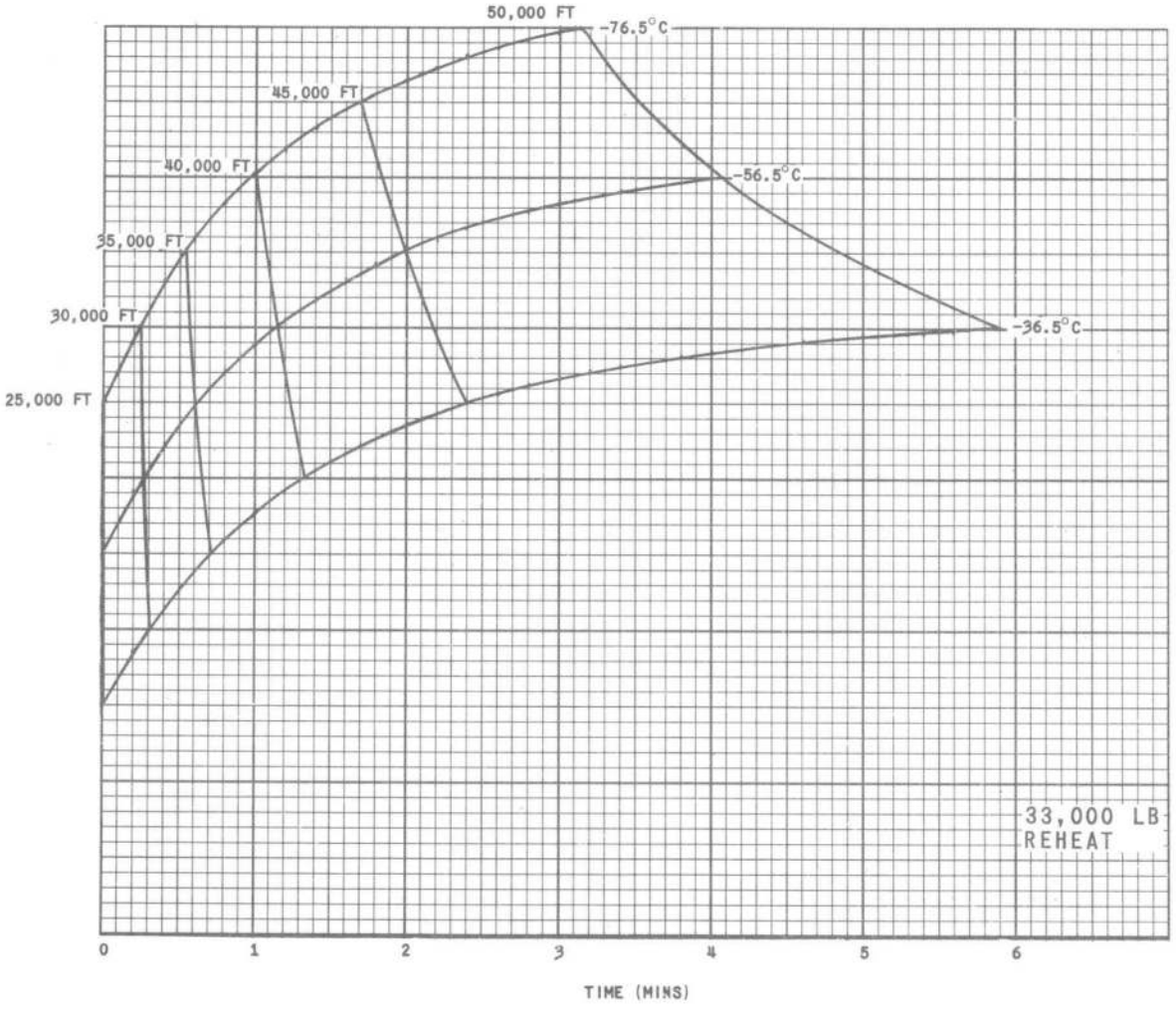
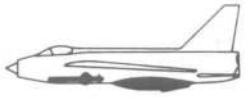


FIG. 3·12A. CLIMB AT 0·87M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE



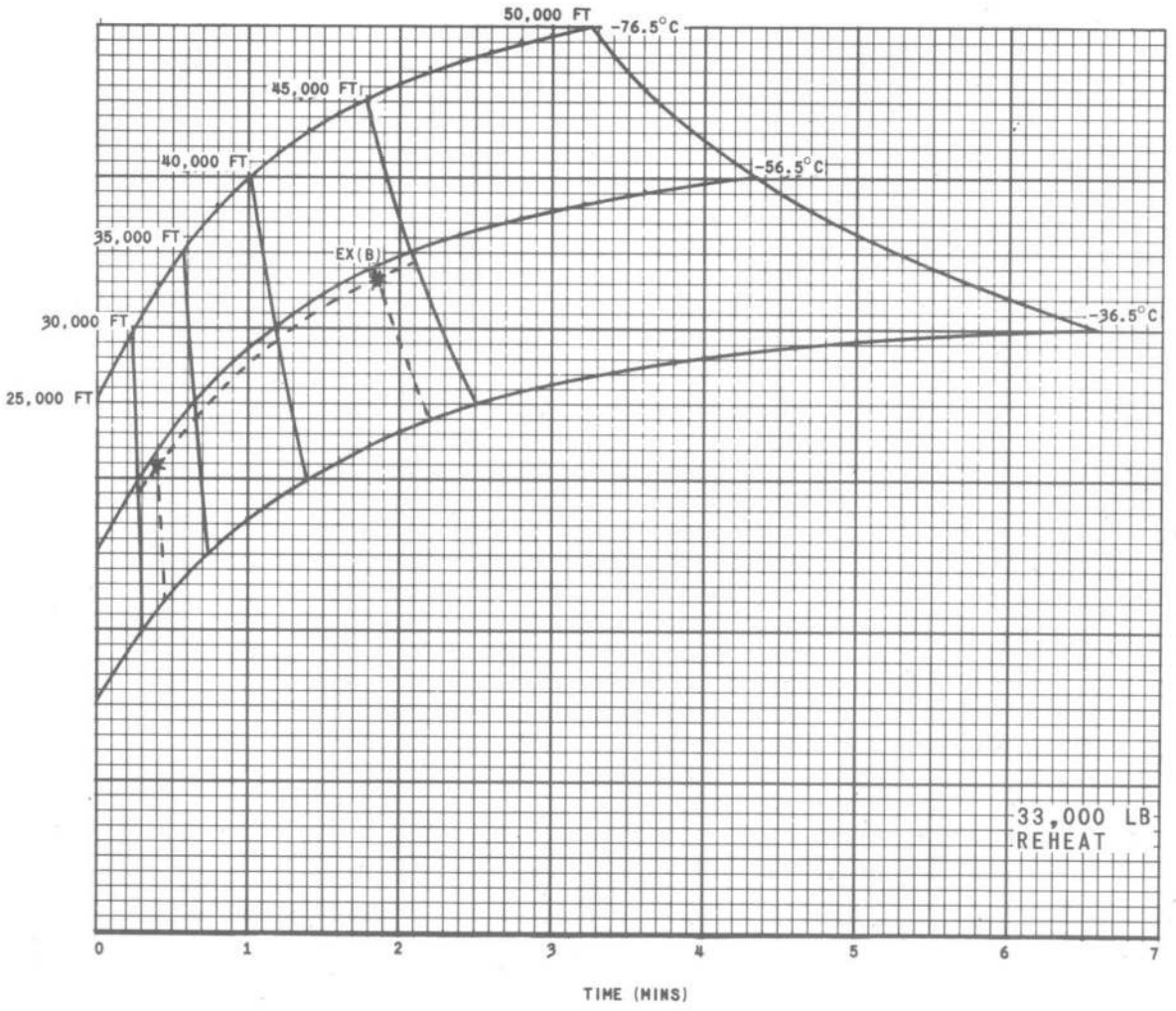
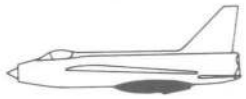


FIG. 3·12B. CLIMB AT 0·87M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE



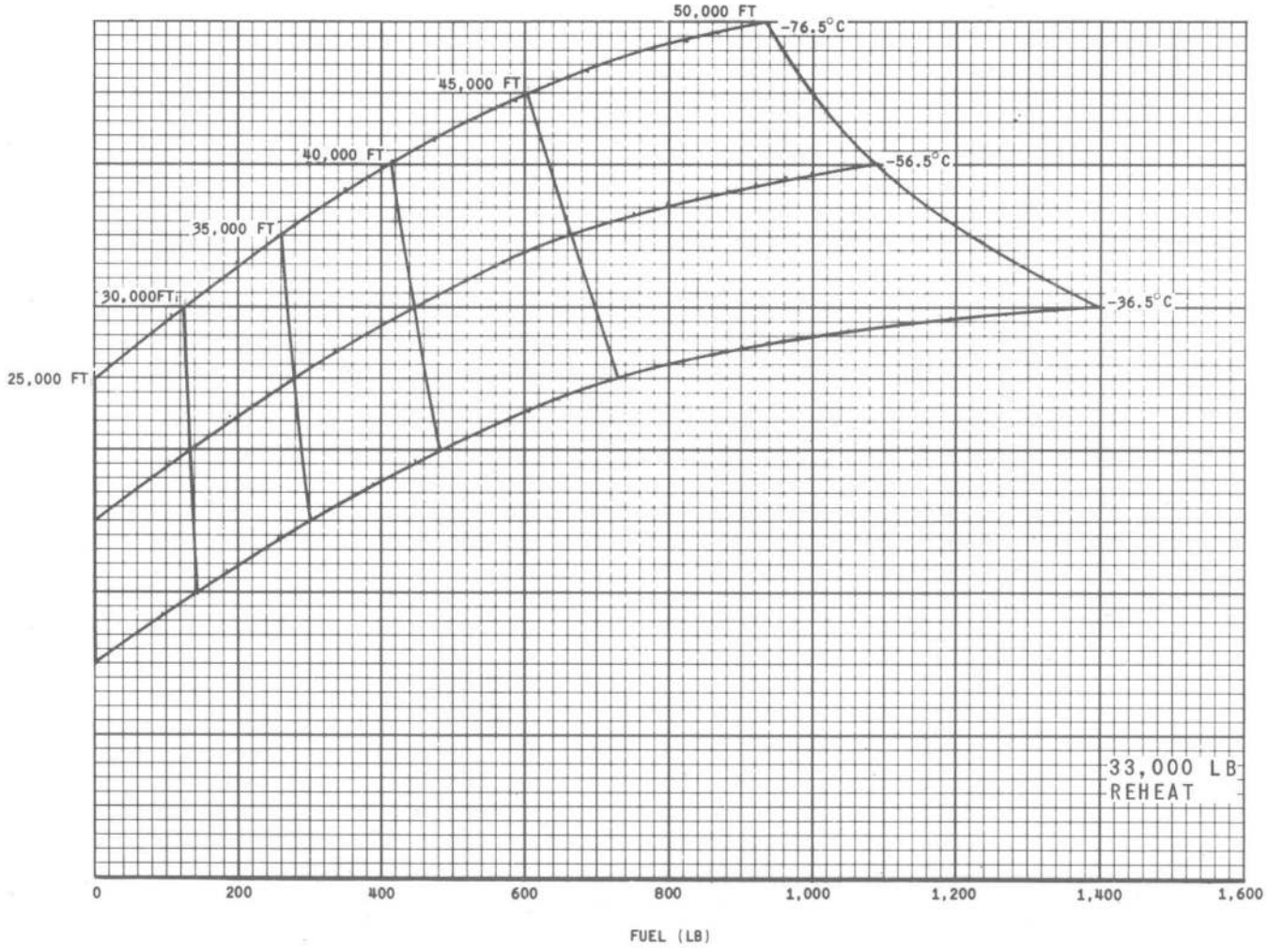
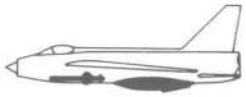


FIG. 3·13A. CLIMB AT 0·87M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE



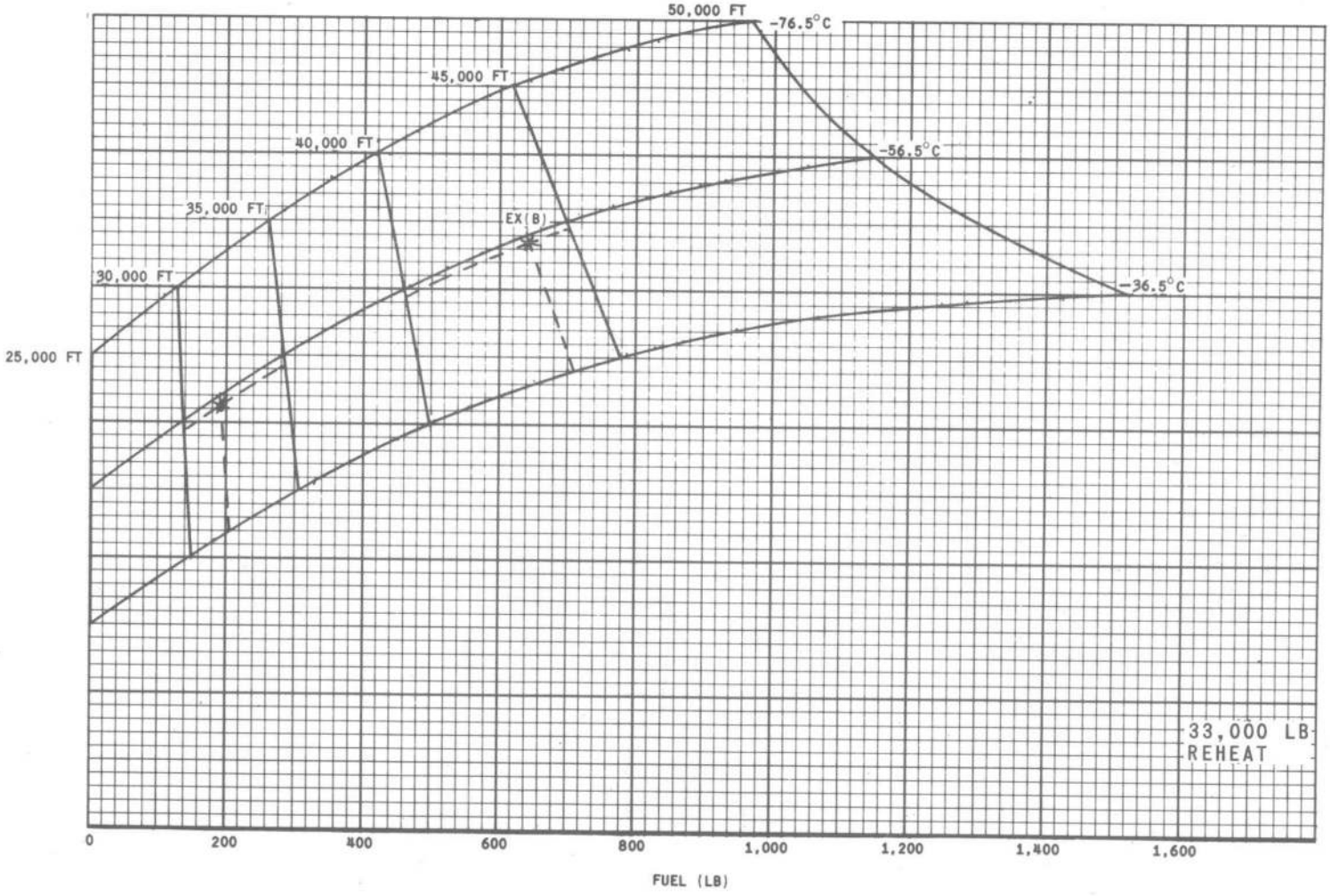


FIG. 3·13B. CLIMB AT 0·87M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

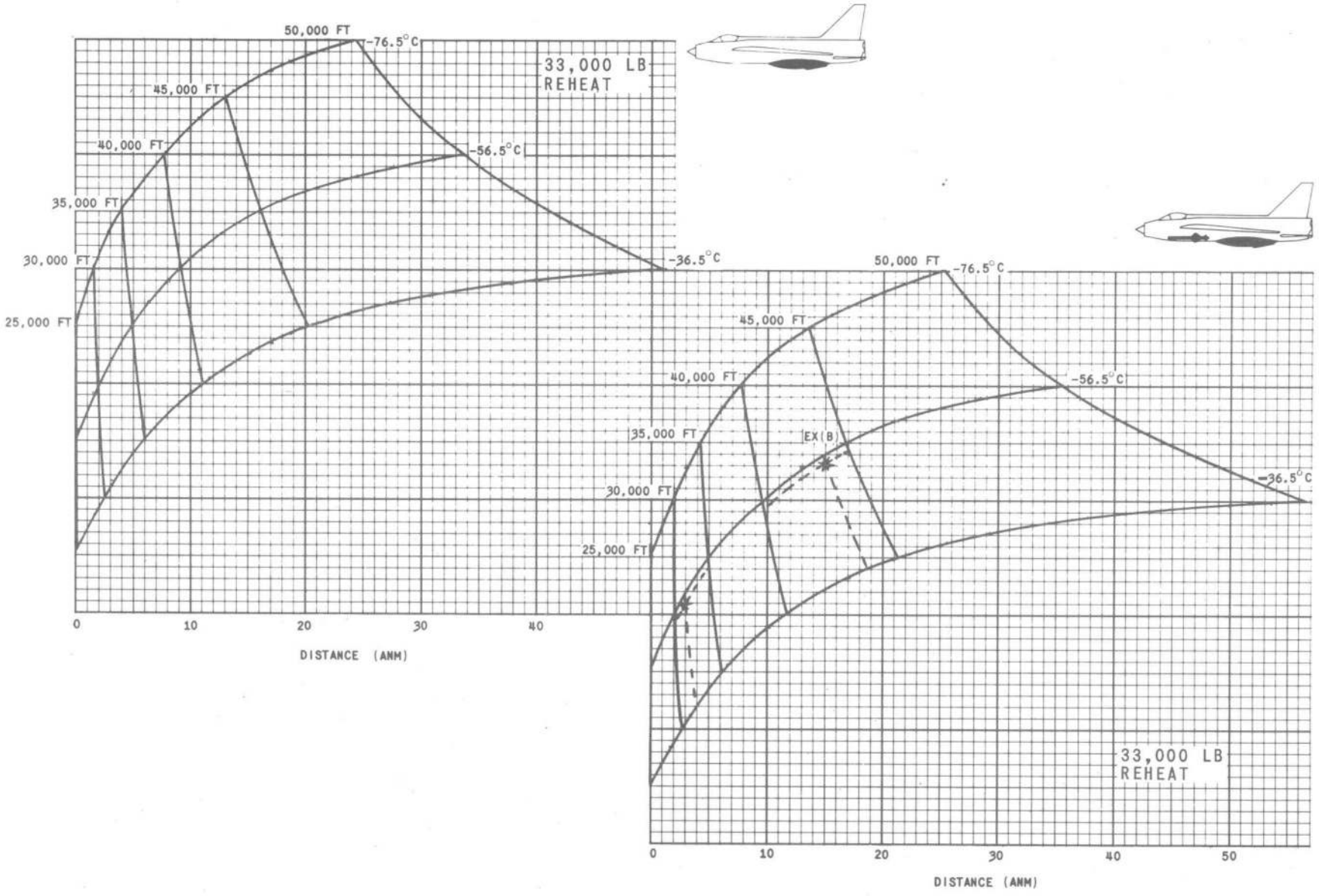


FIG. 3·14. CLIMB AT 0·87M IN ISOTHERMAL ATMOSPHERE DISTANCE TO ALTITUDE

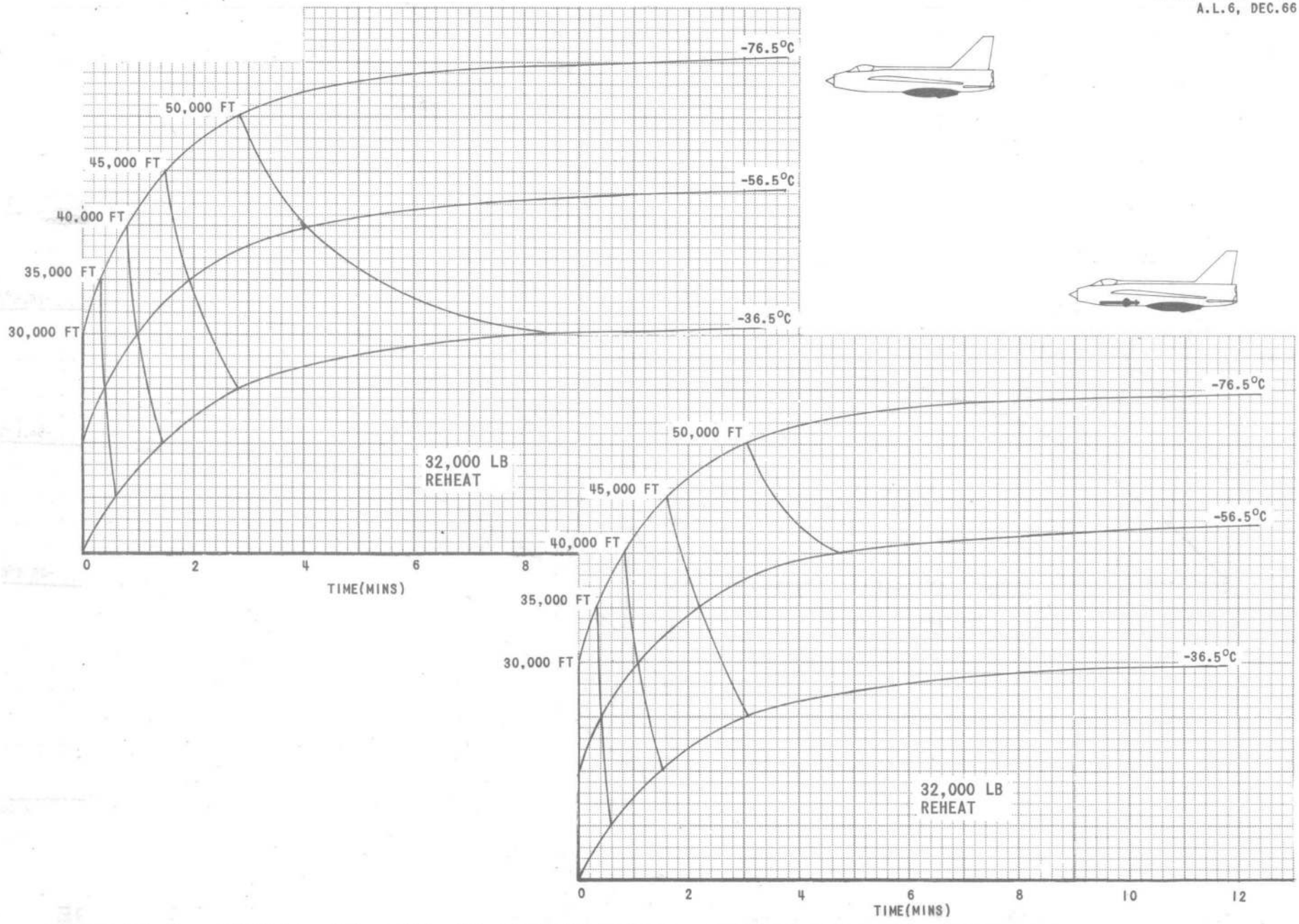


FIG.3.14/1. CLIMB AT 1.1M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE

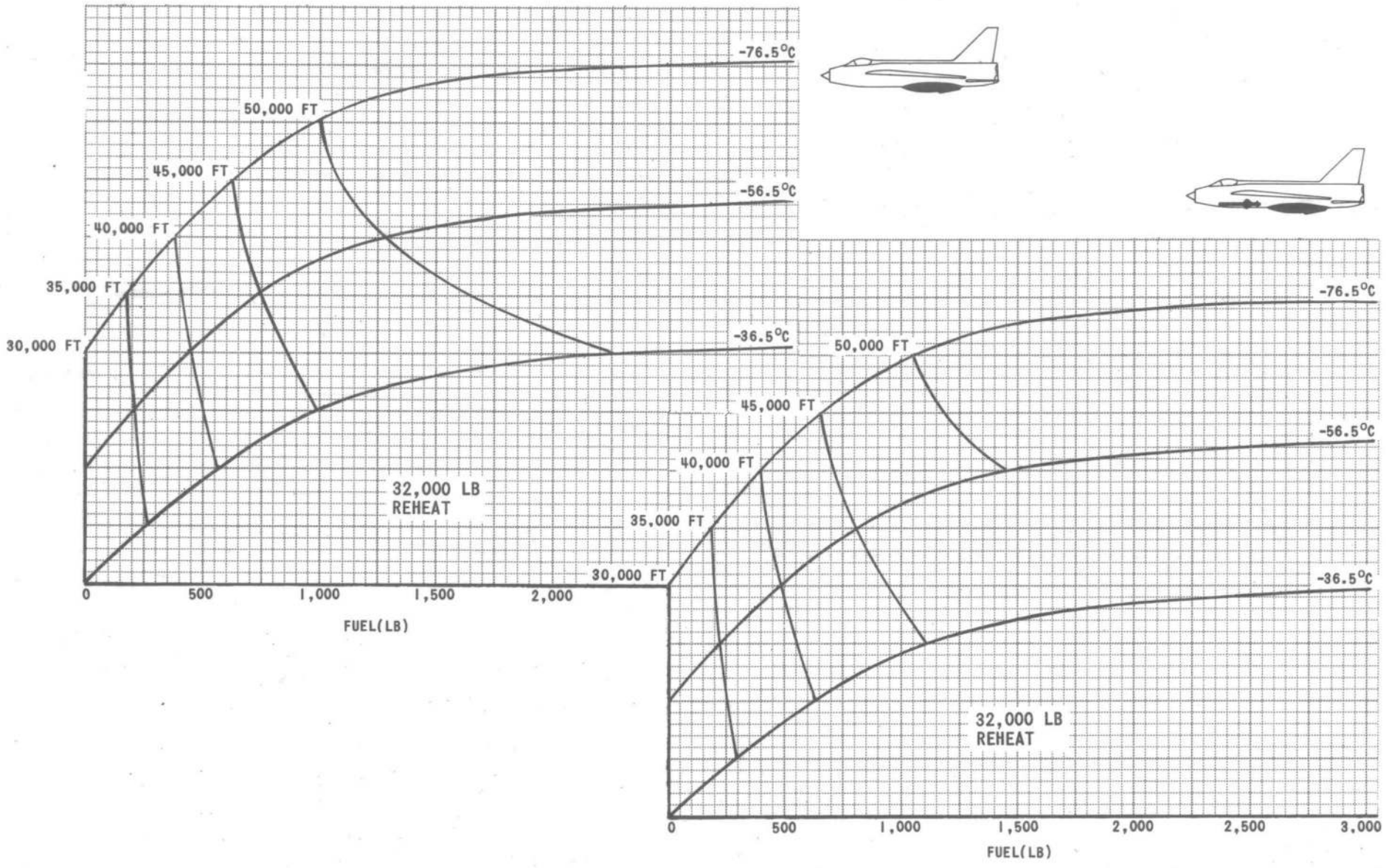


FIG.3.14/2. CLIMB AT 1.1M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

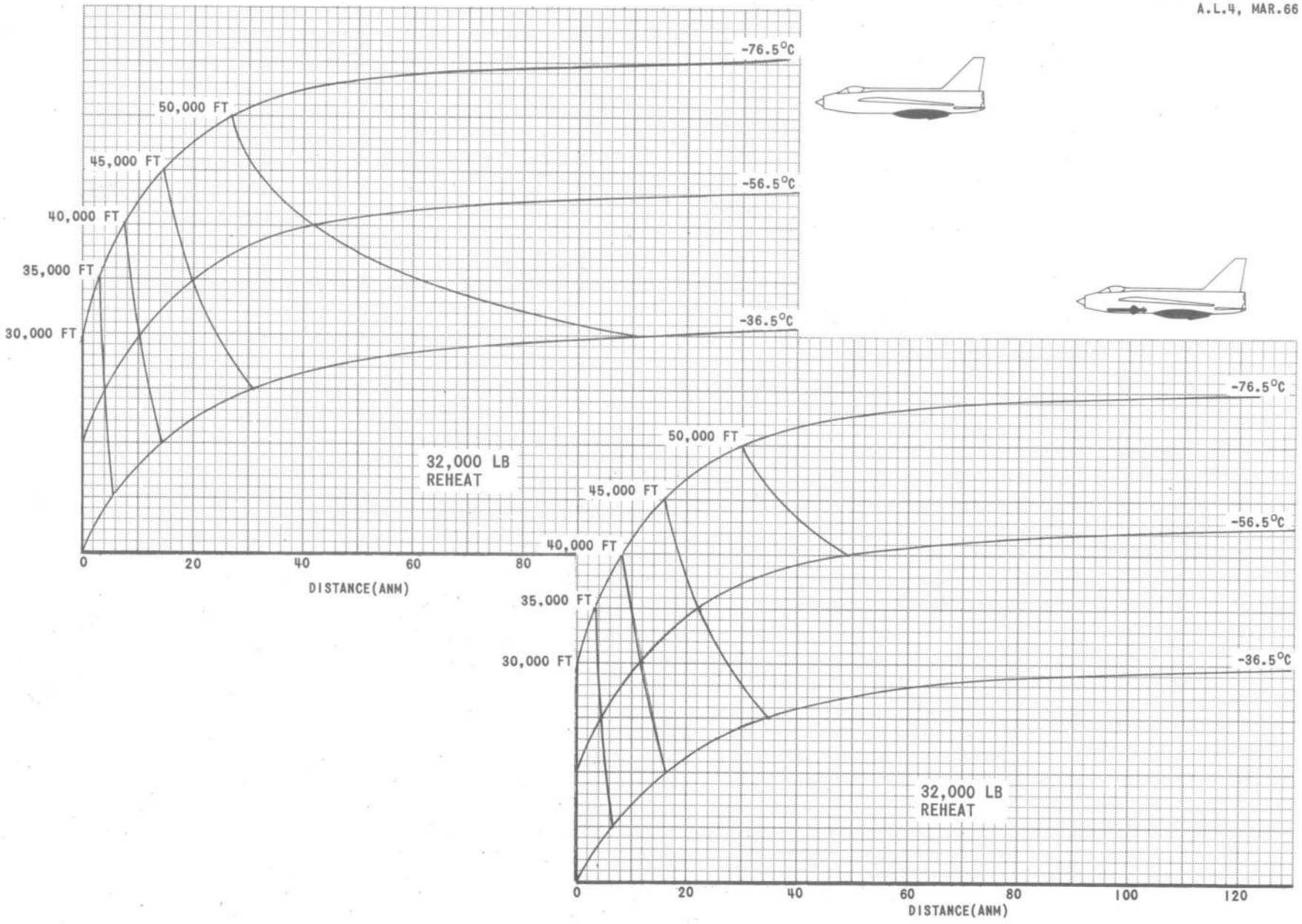


FIG.3.14/3. CLIMB AT 1.1M IN ISOTHERMAL ATMOSPHERE DISTANCE TO ALTITUDE

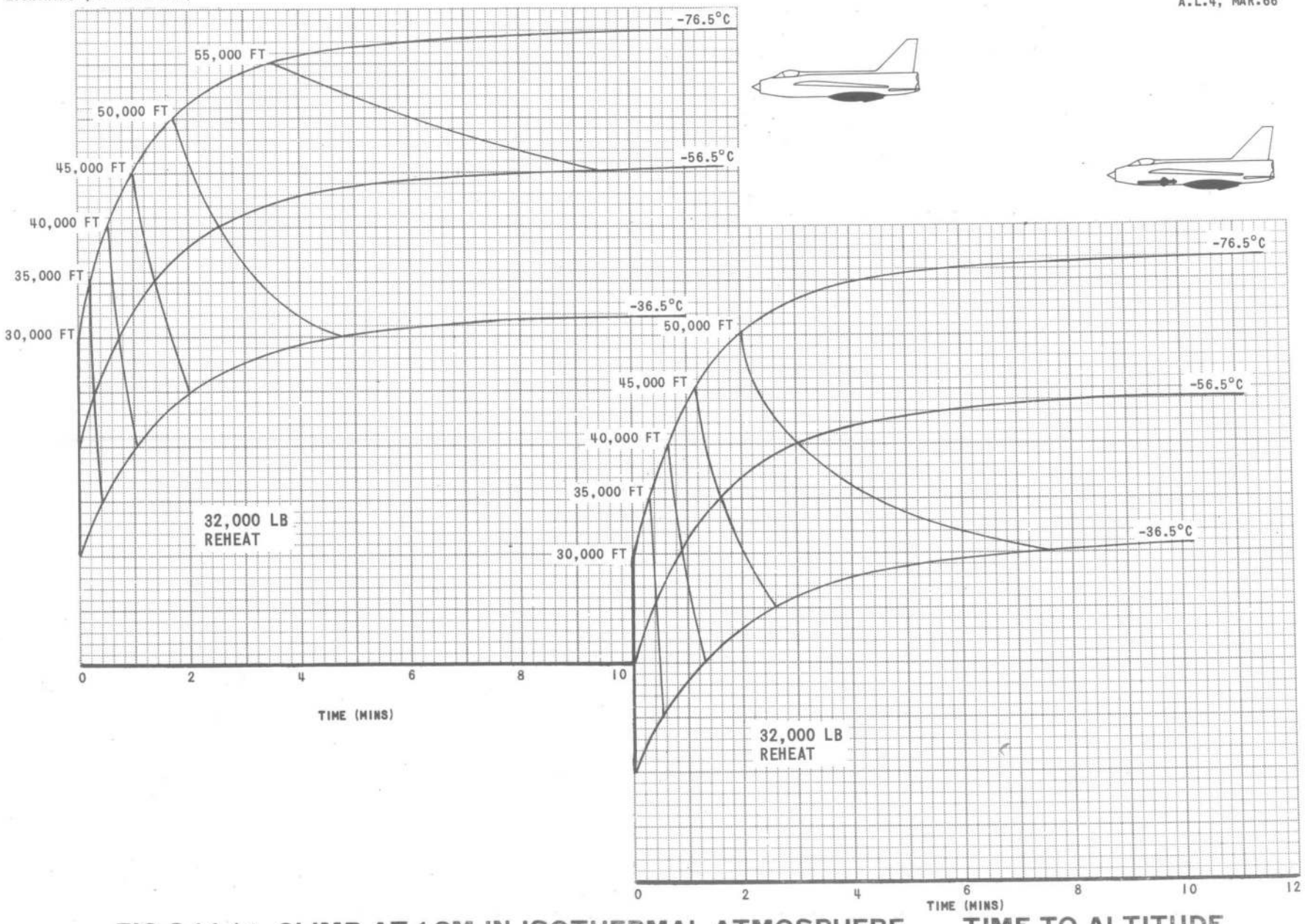


FIG.3.14/4. CLIMB AT 1.3M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE

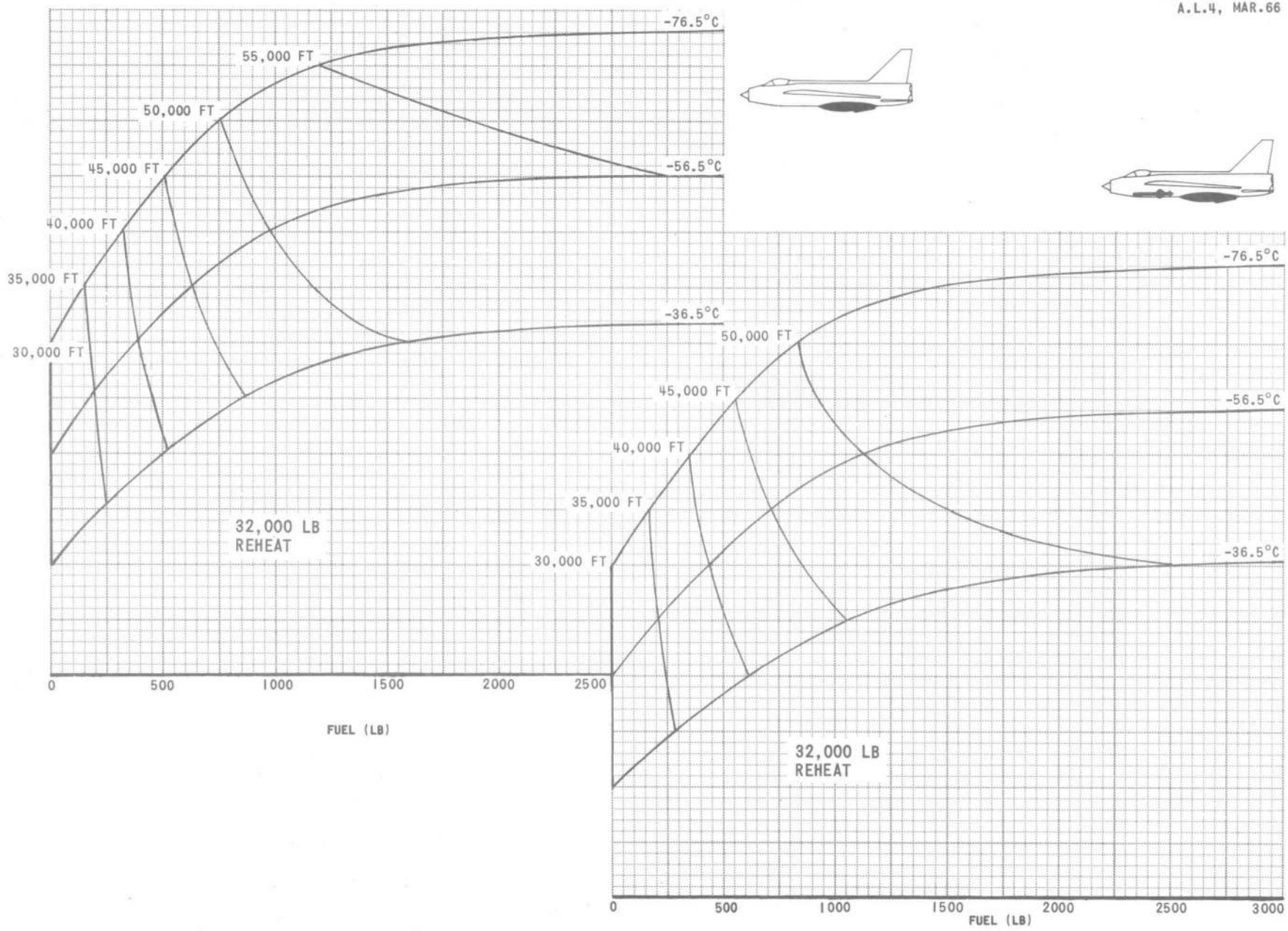
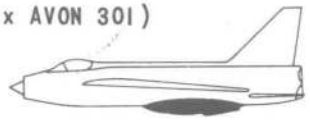
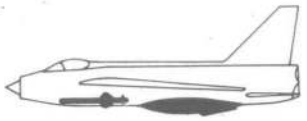
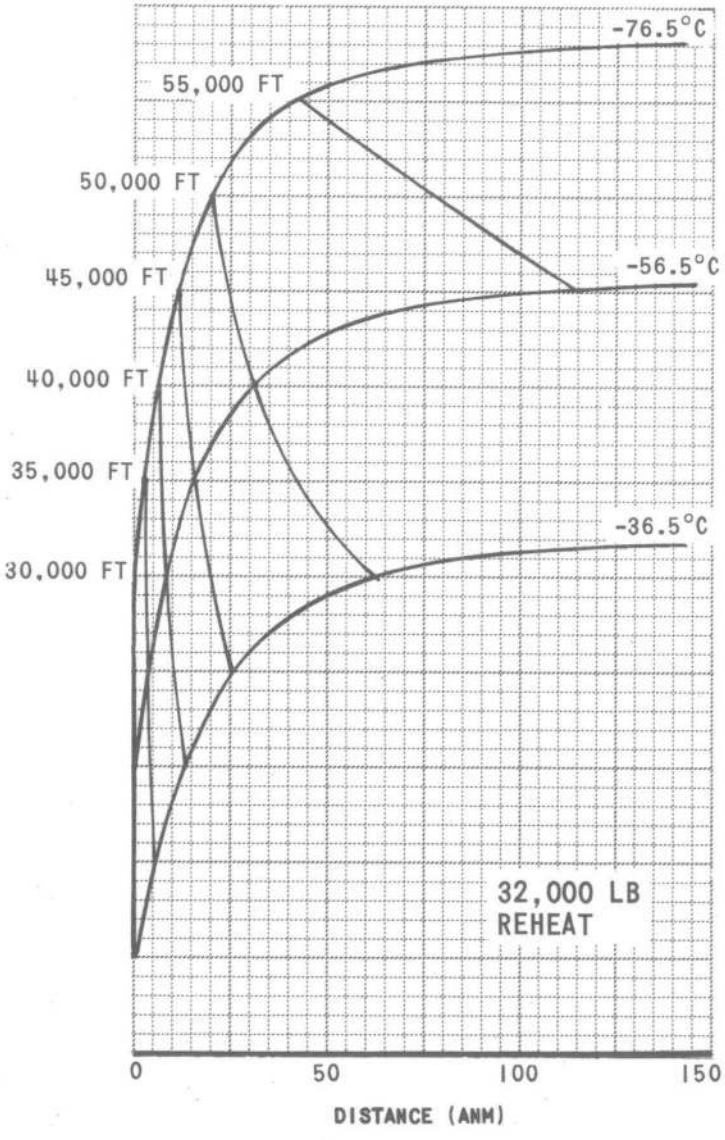


FIG.3.14/5. CLIMB AT 1.3M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE







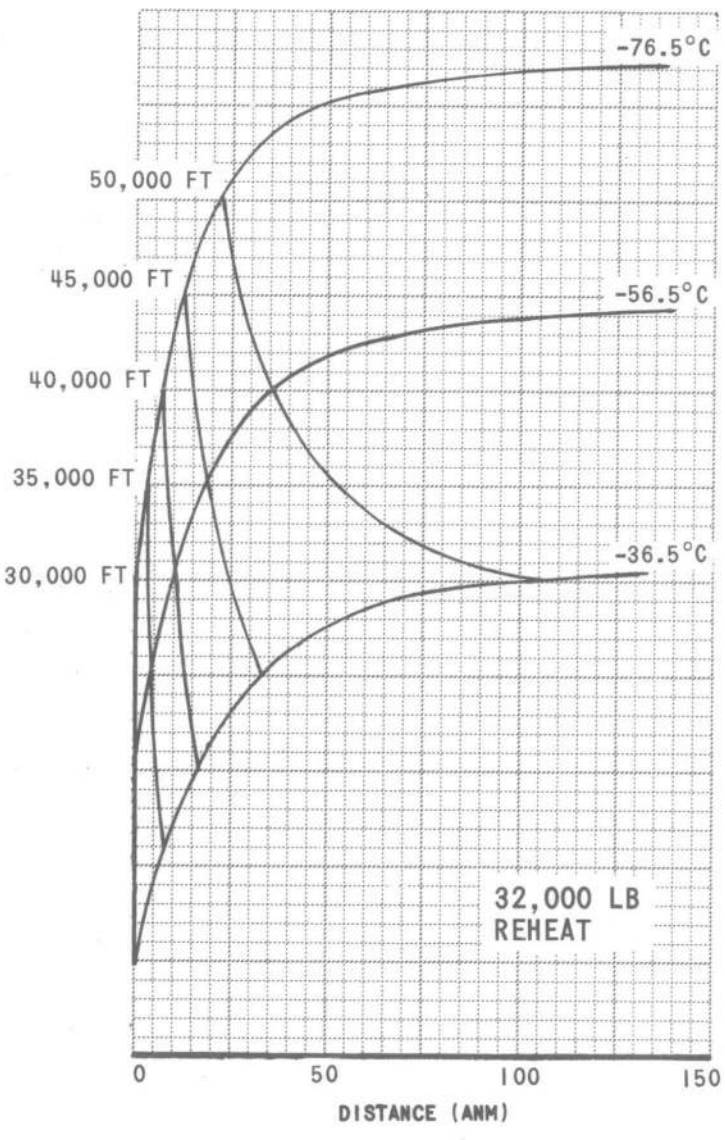


FIG.3.14/6. CLIMB AT 1.3M IN ISOTHERMAL ATMOSPHERE - DISTANCE TO ALTITUDE

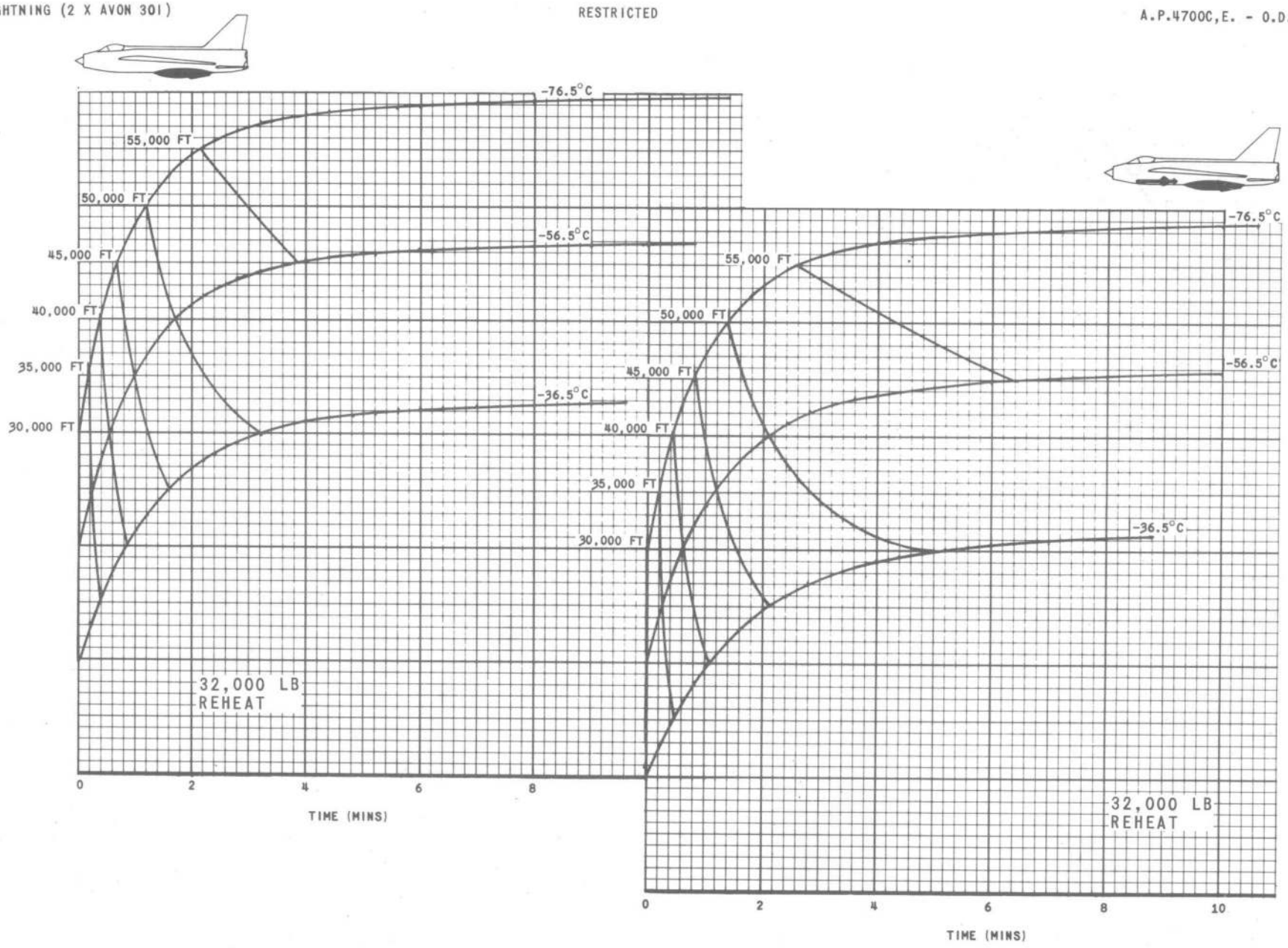


FIG. 3·15. CLIMB AT 1·5M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE

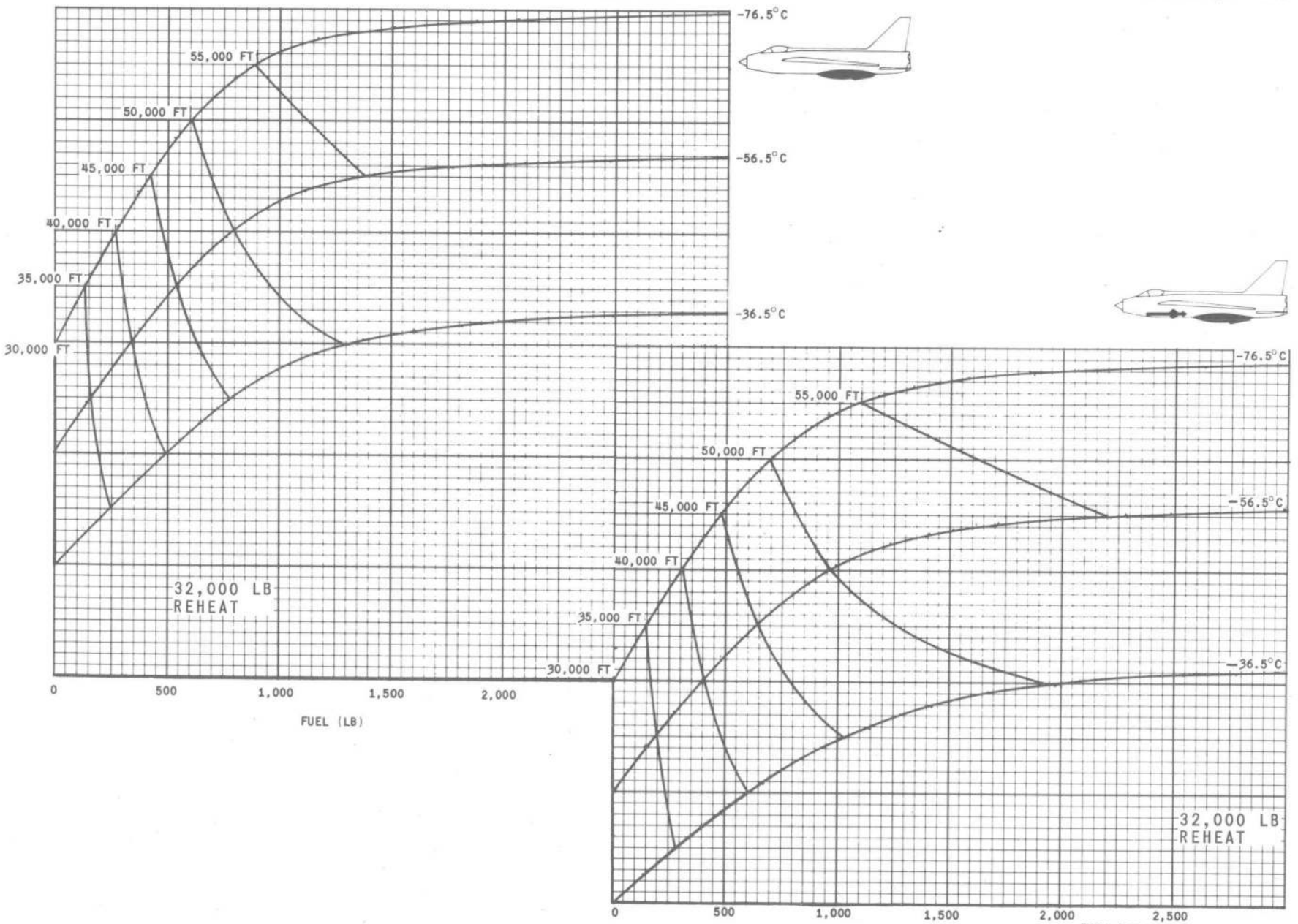


FIG. 3·16. CLIMB AT 1·5M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

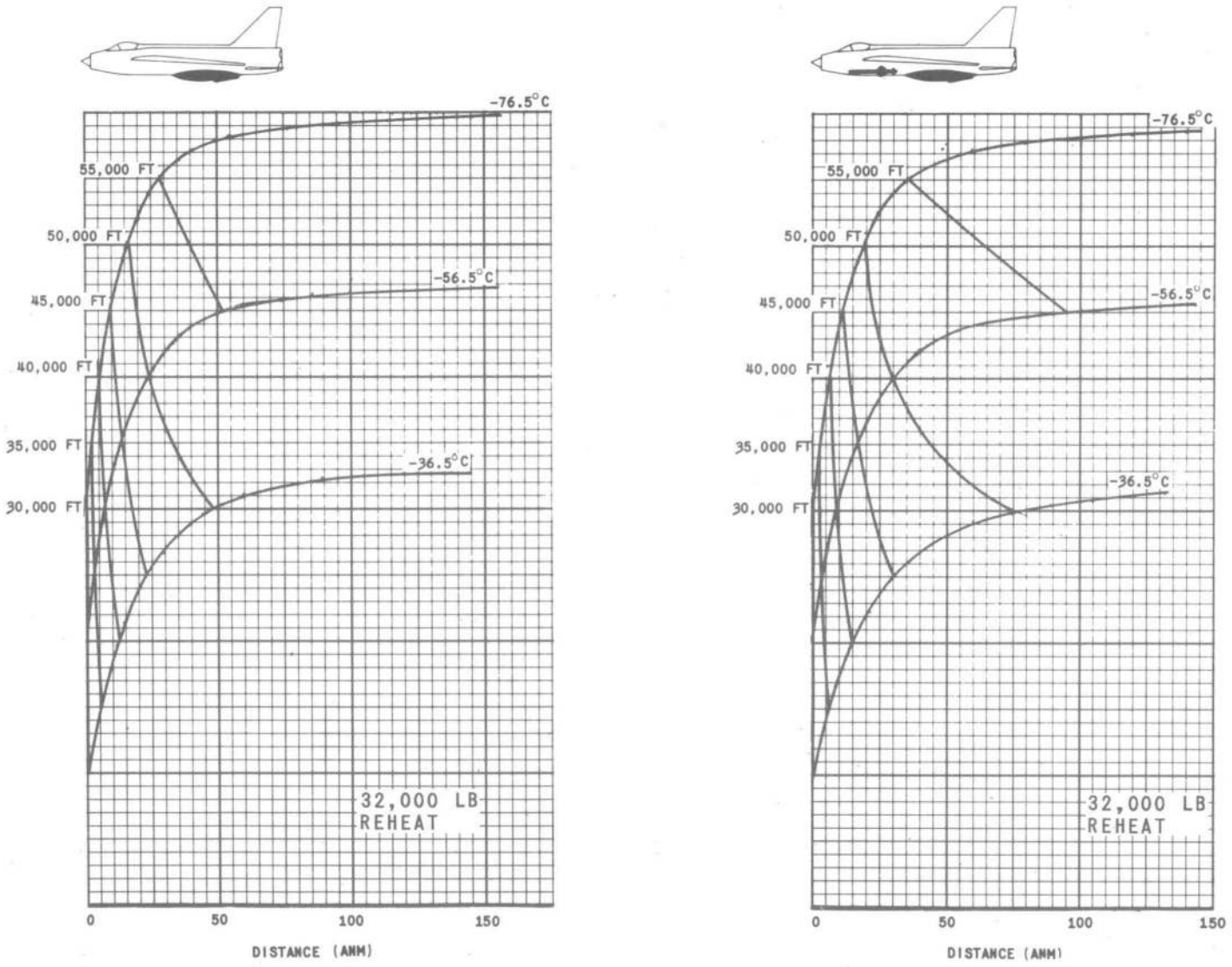


FIG. 3·17. CLIMB AT 1·5M IN ISOTHERMAL ATMOSPHERE DISTANCE TO ALTITUDE

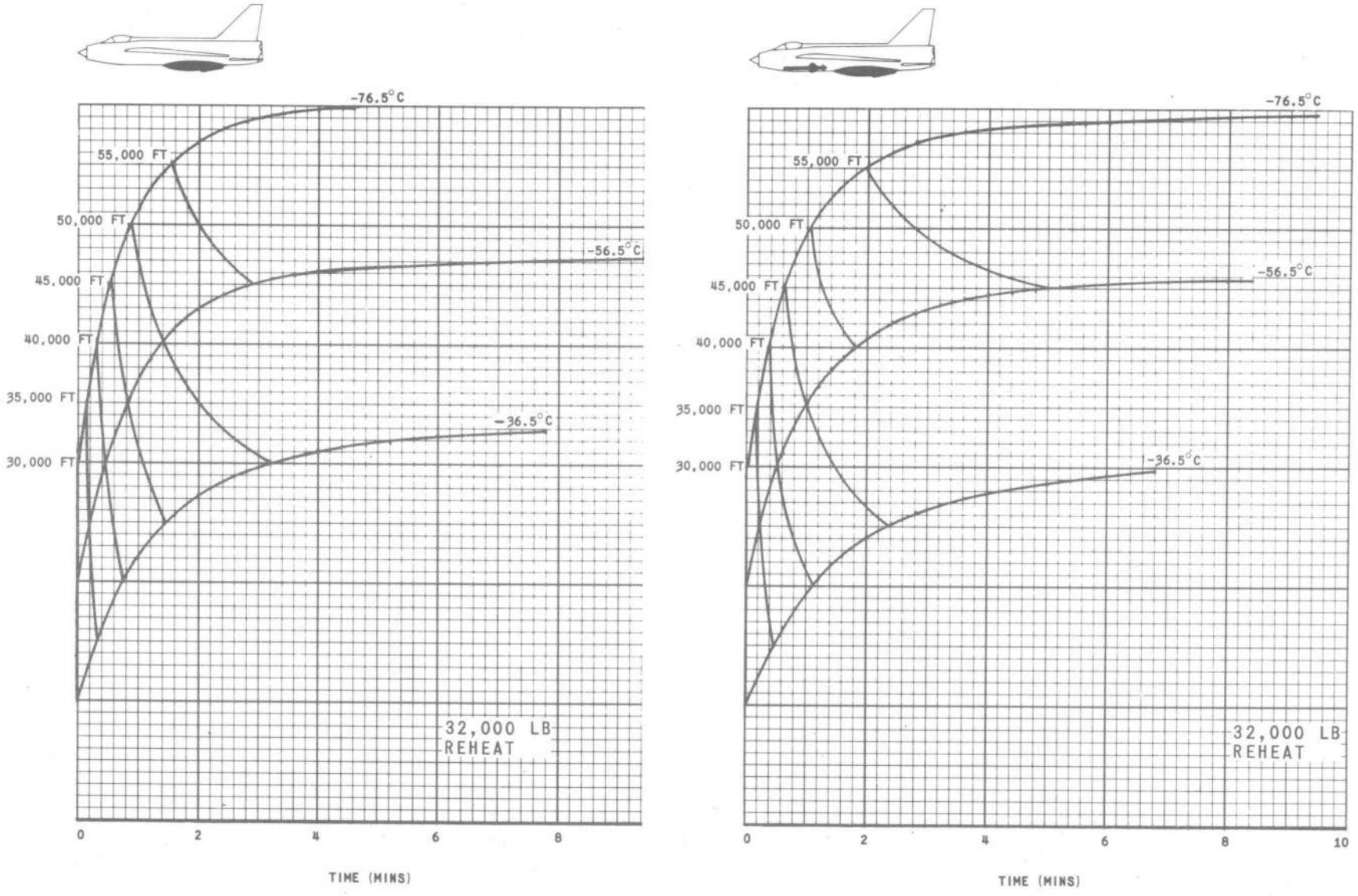


FIG. 3·18. CLIMB AT 1·7M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE

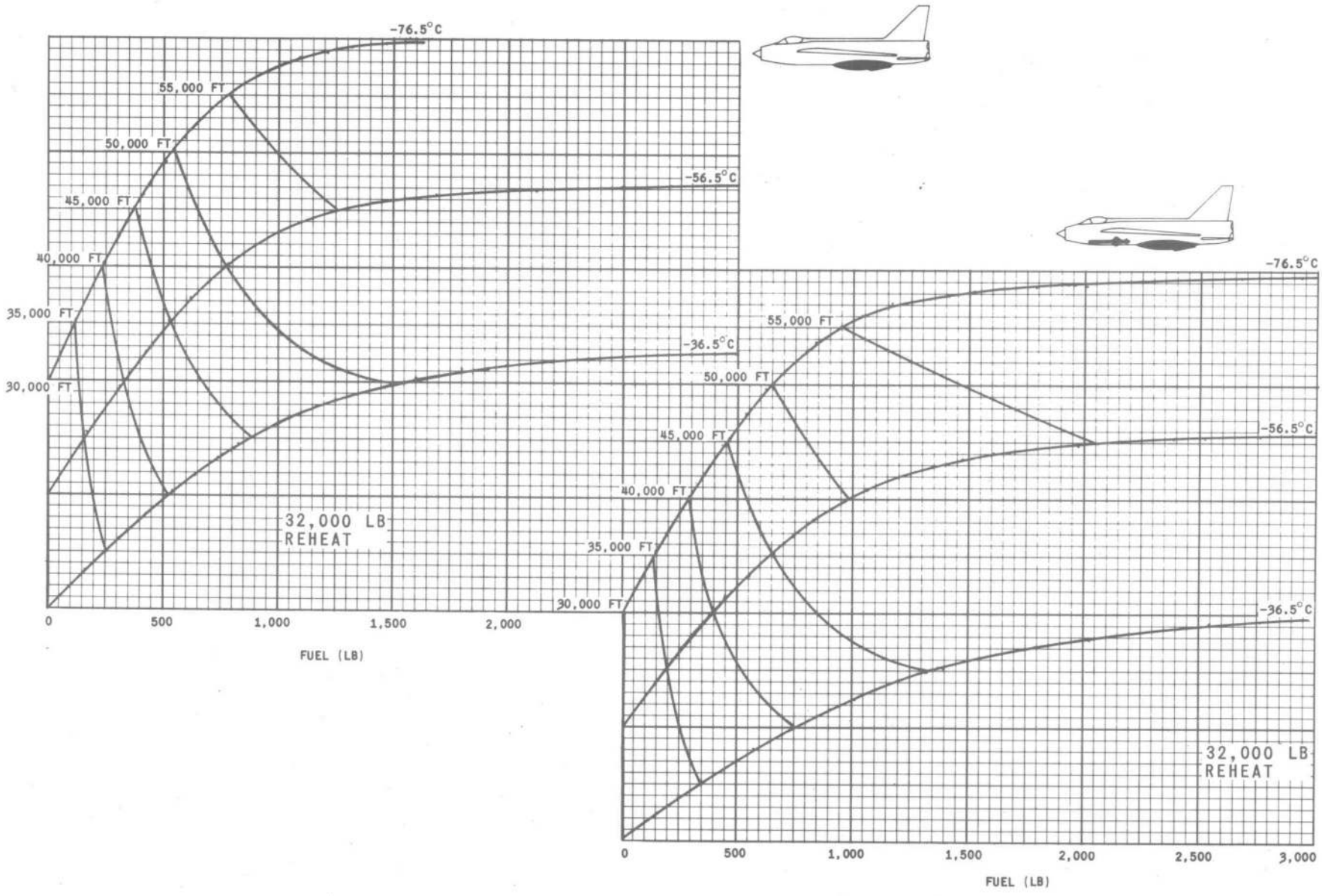


FIG. 3·19. CLIMB AT 1·7M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

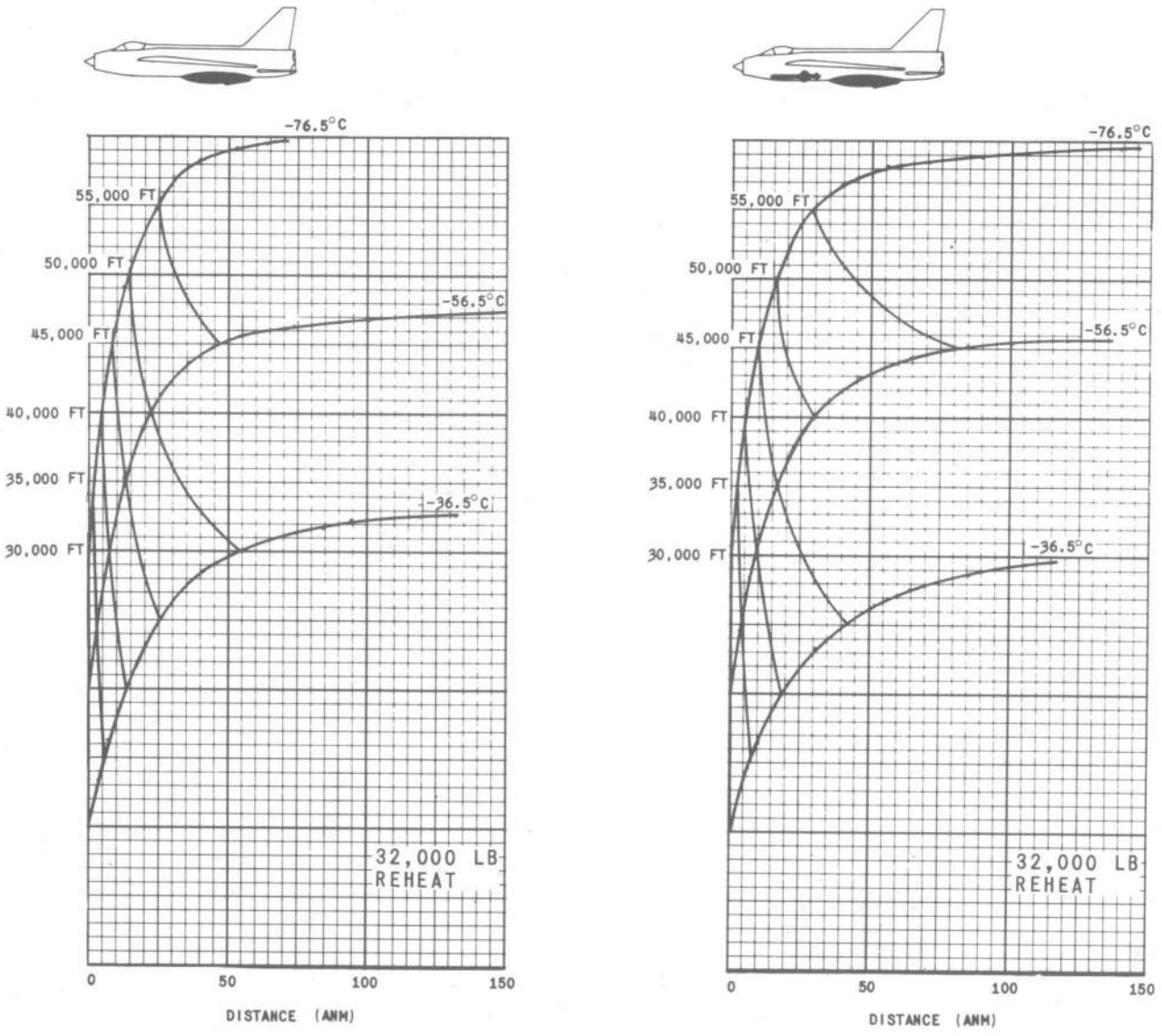
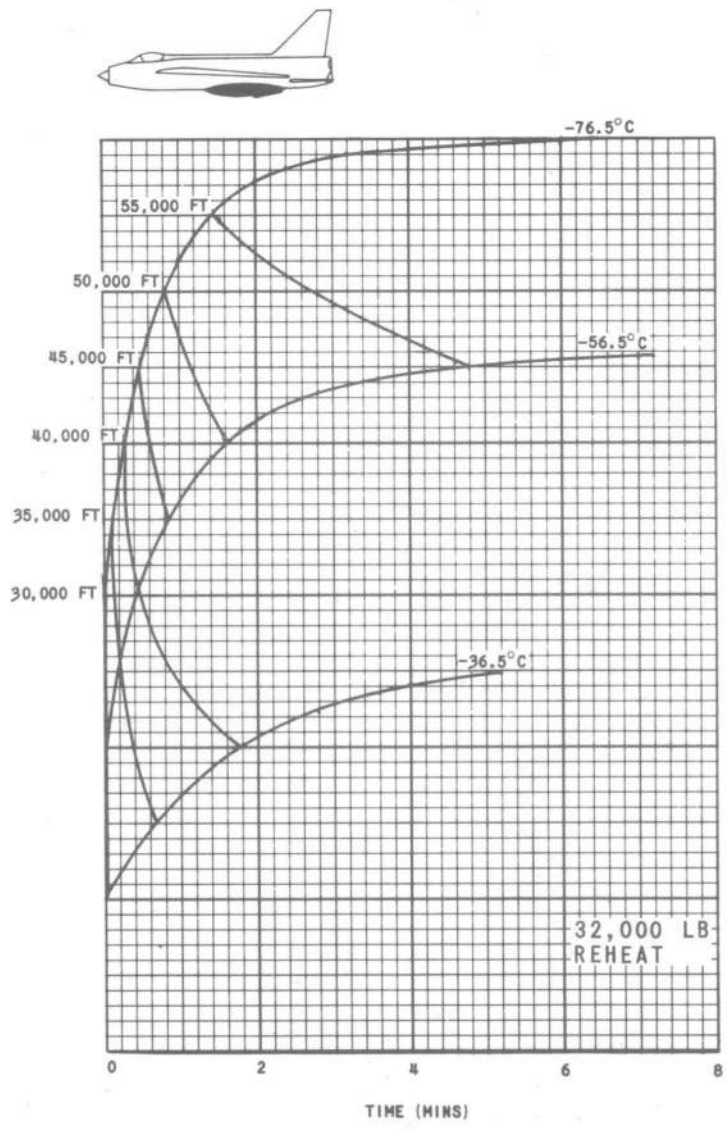


FIG. 3·20. CLIMB AT 1·7M IN ISOTHERMAL ATMOSPHERE DISTANCE TO ALTITUDE



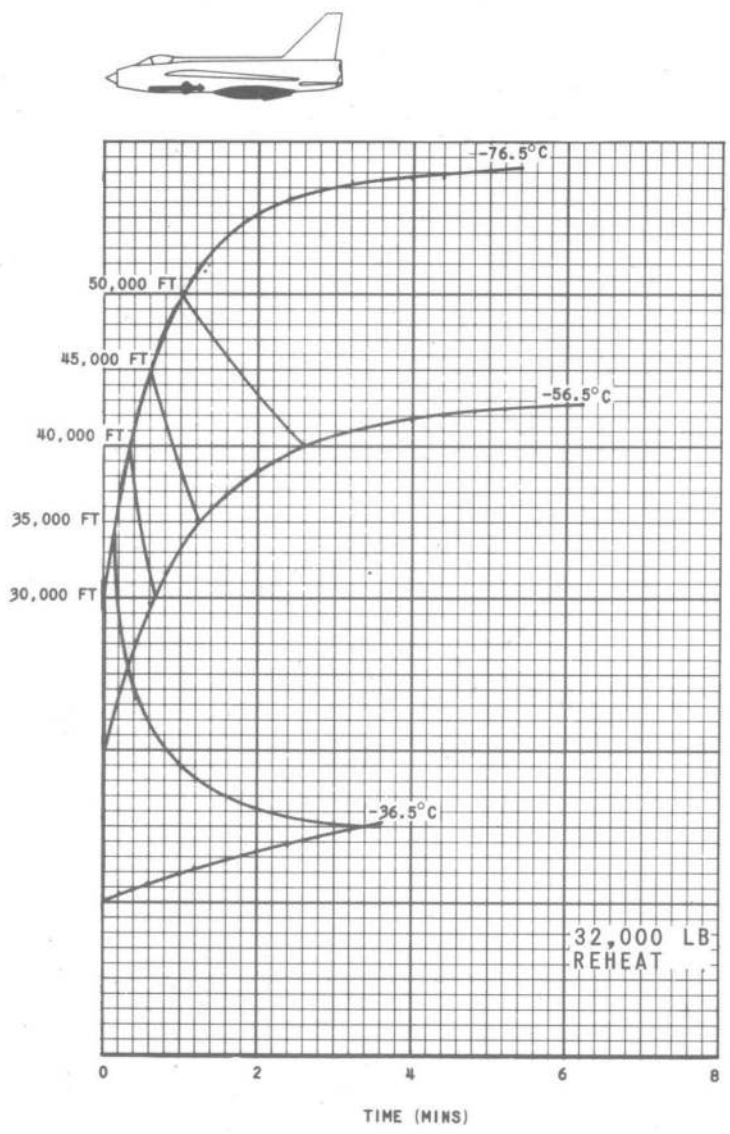


FIG. 3·21. CLIMB AT 1·9M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE

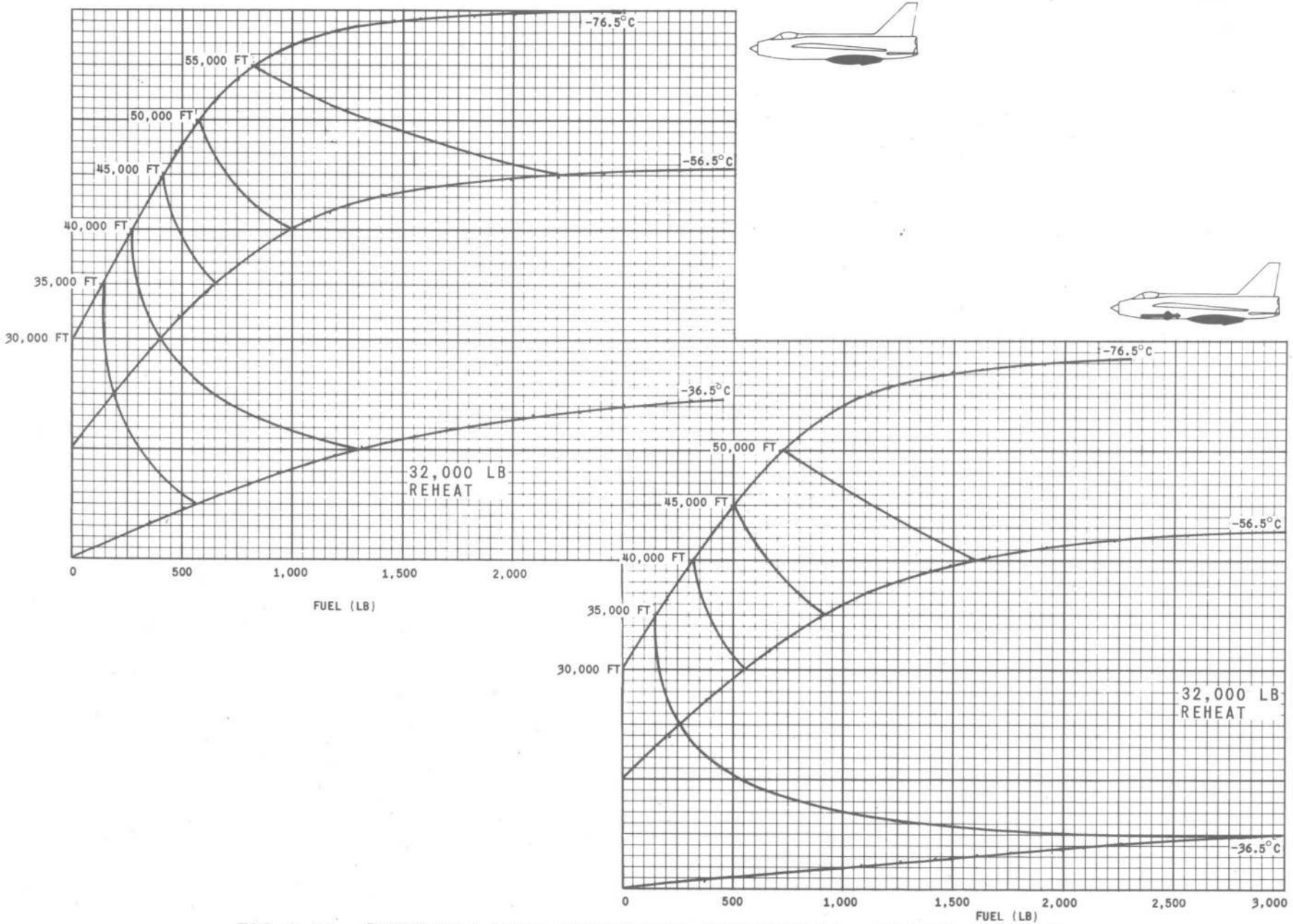


FIG. 3·22. CLIMB AT 1·9M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

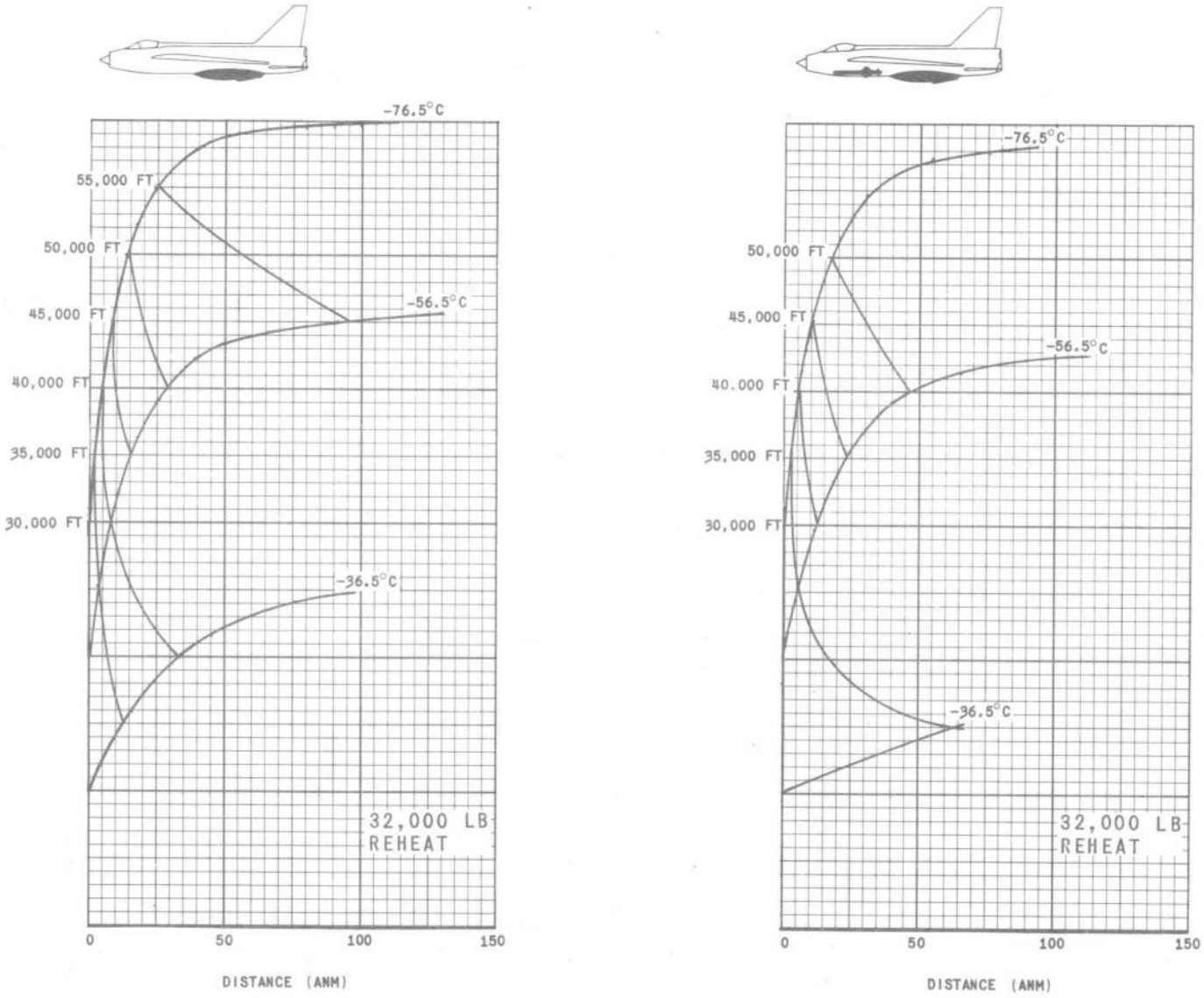


FIG. 3·23. CLIMB AT 1·9M IN ISOTHERMAL ATMOSPHERE DISTANCE TO ALTITUDE

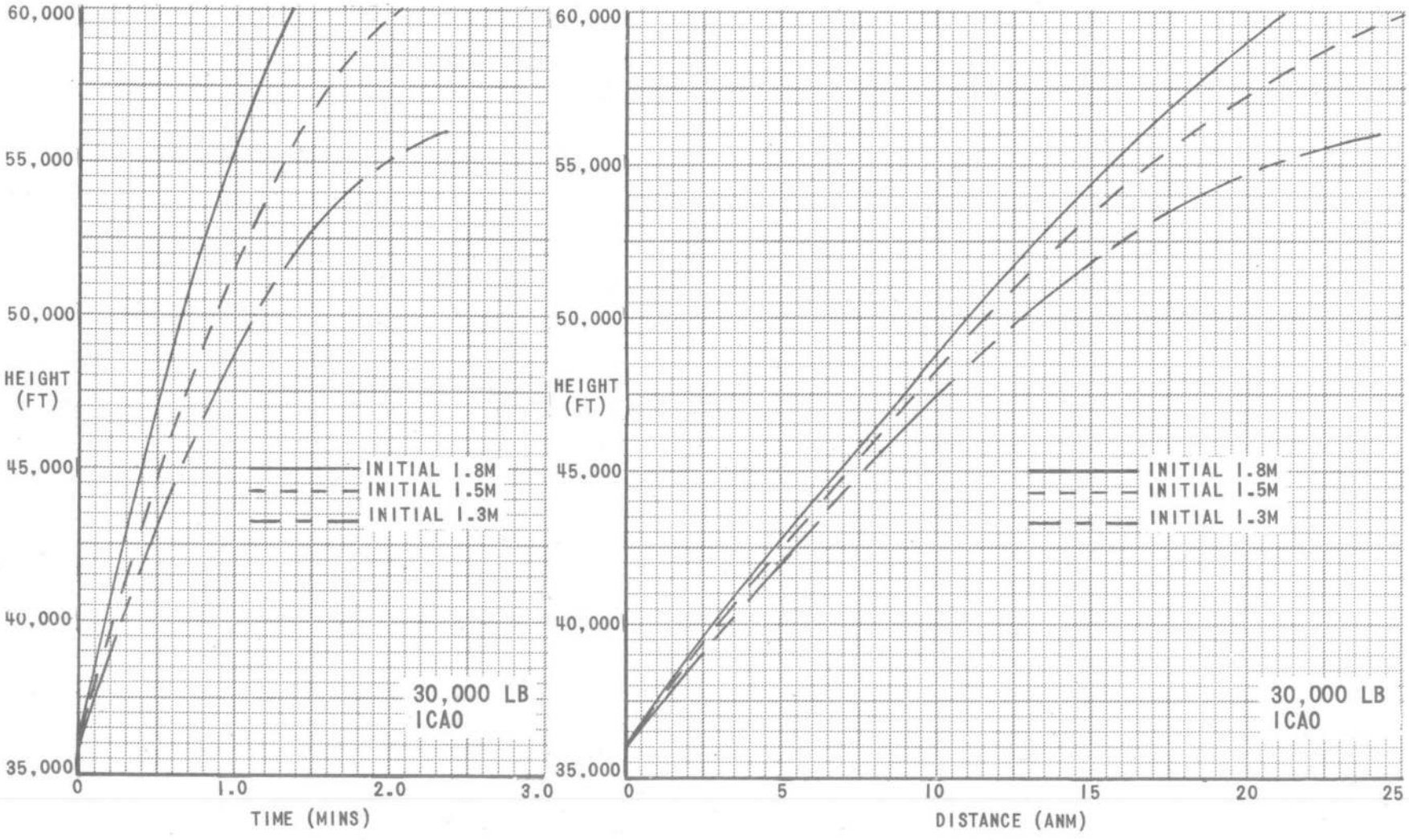


FIG.3.23/1. CLIMB AT CONSTANT A/C ATTITUDE θ =15° TIME AND DISTANCE

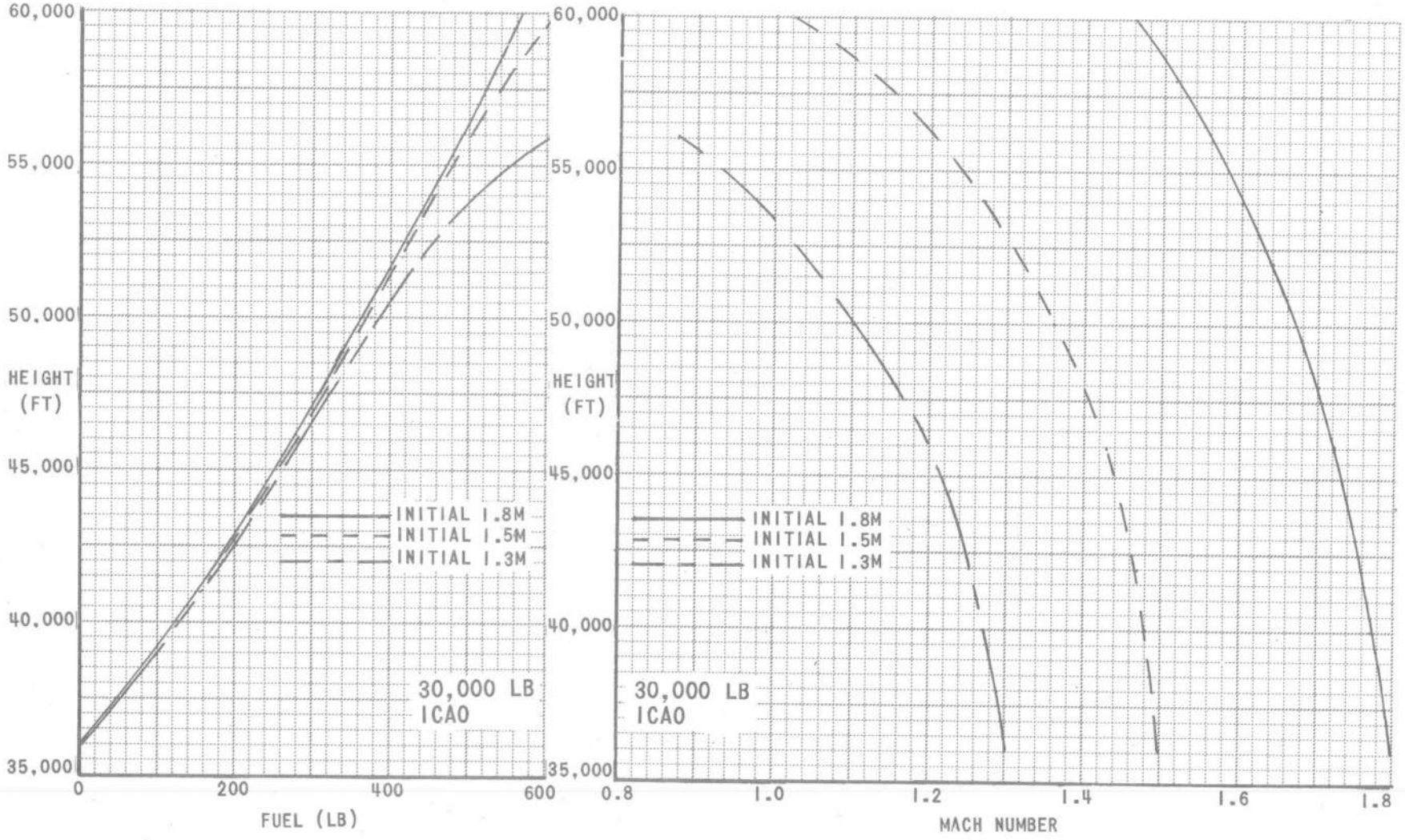
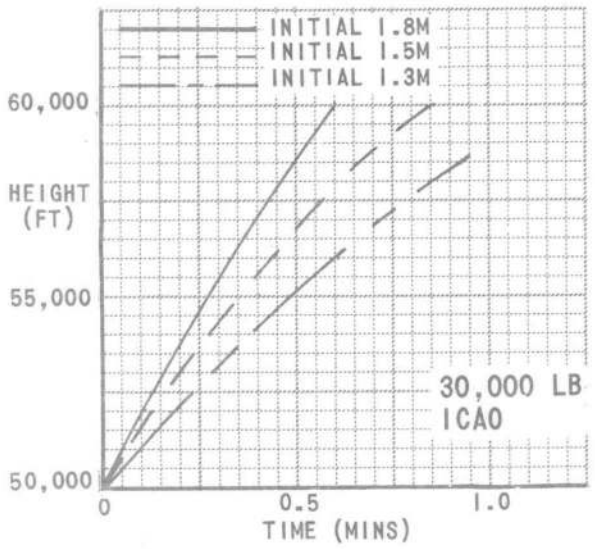
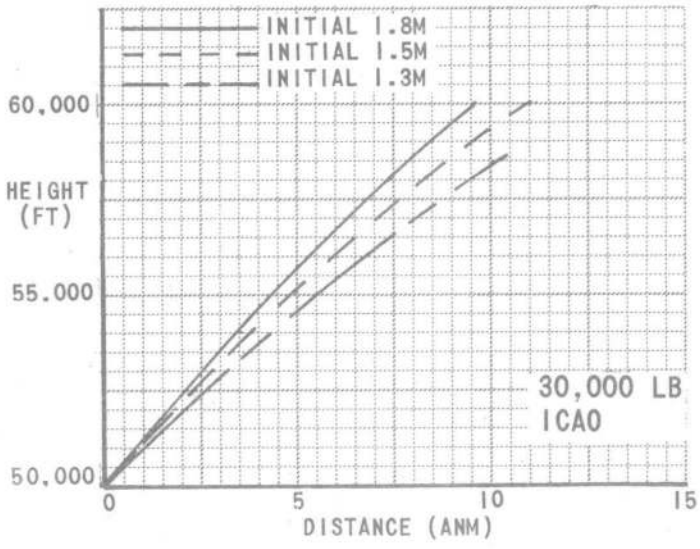
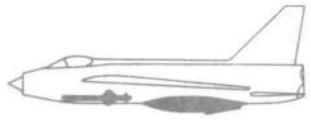
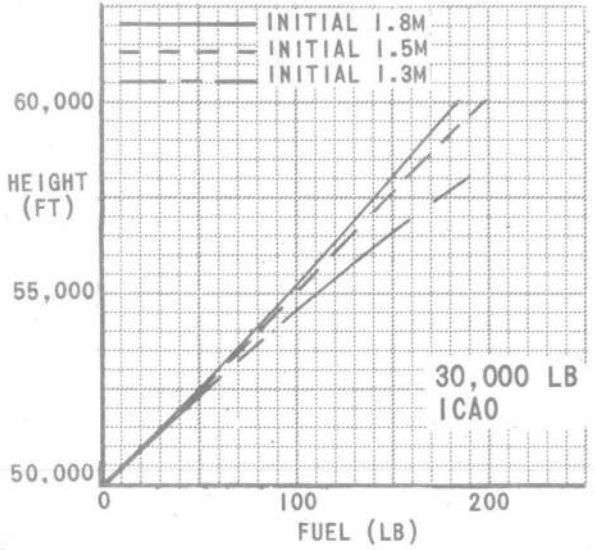


FIG.3.23/2. CLIMB AT CONSTANT A/C ATTITUDE θ =15° FUEL AND MACH NO.









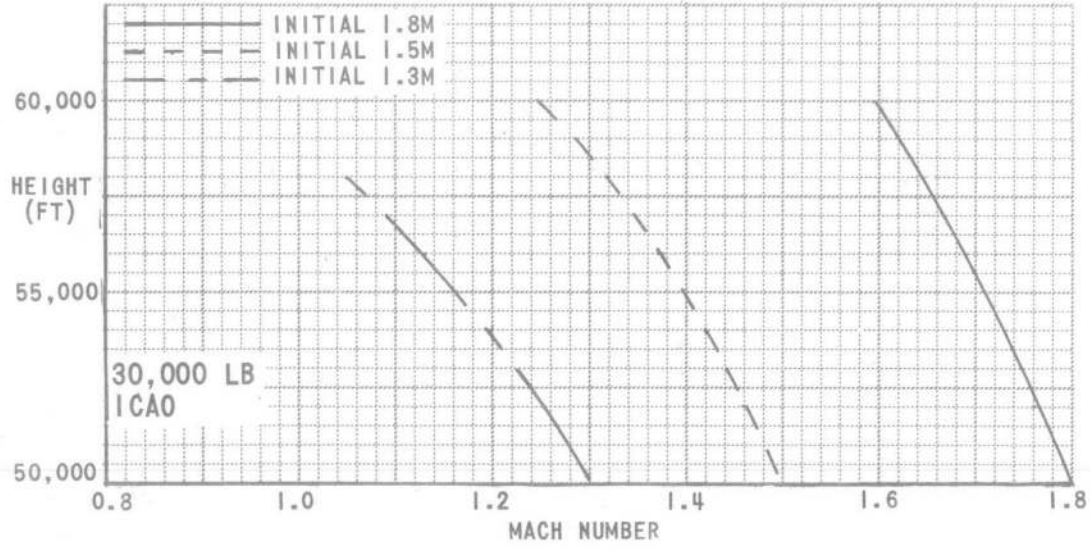
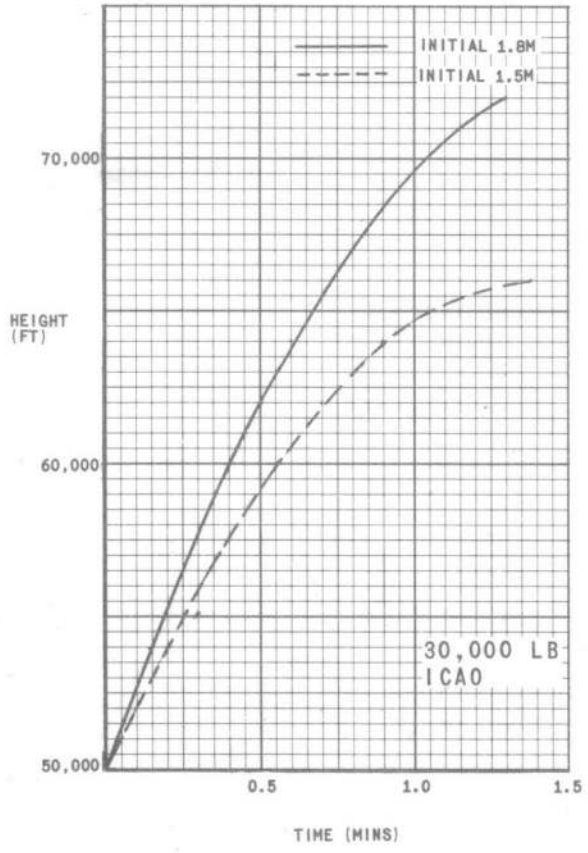


FIG.3.23/3. CLIMB AT CONSTANT A/C ATTITUDE θ =15°
TIME, DISTANCE, FUEL, & MACH NO.



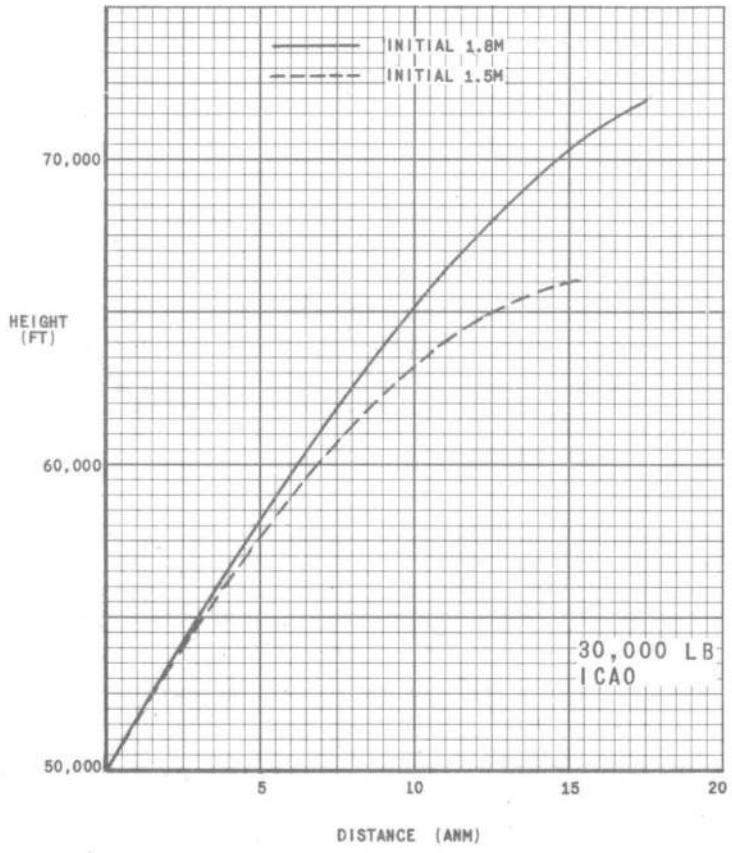
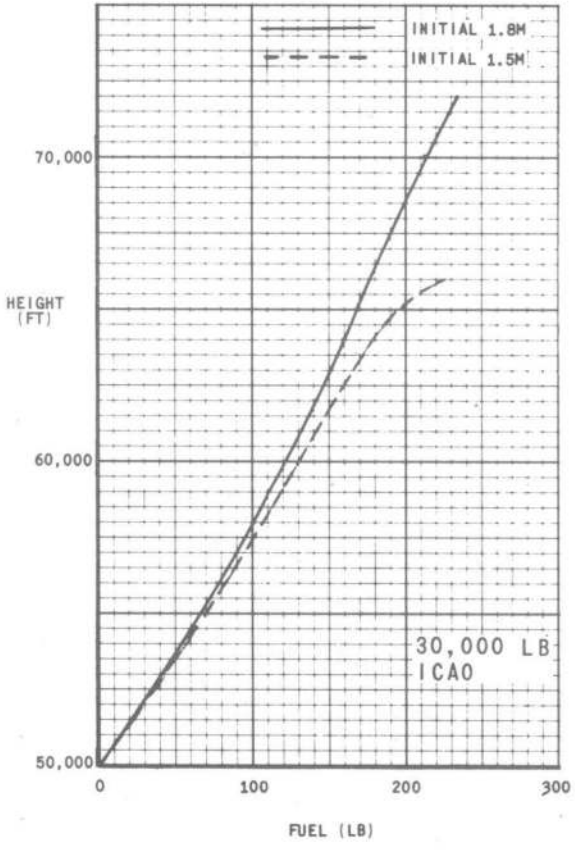


FIG. 3·24. CLIMB AT CONSTANT A/C ATTITUDE $\theta = 20^{o}$ TIME AND DISTANCE



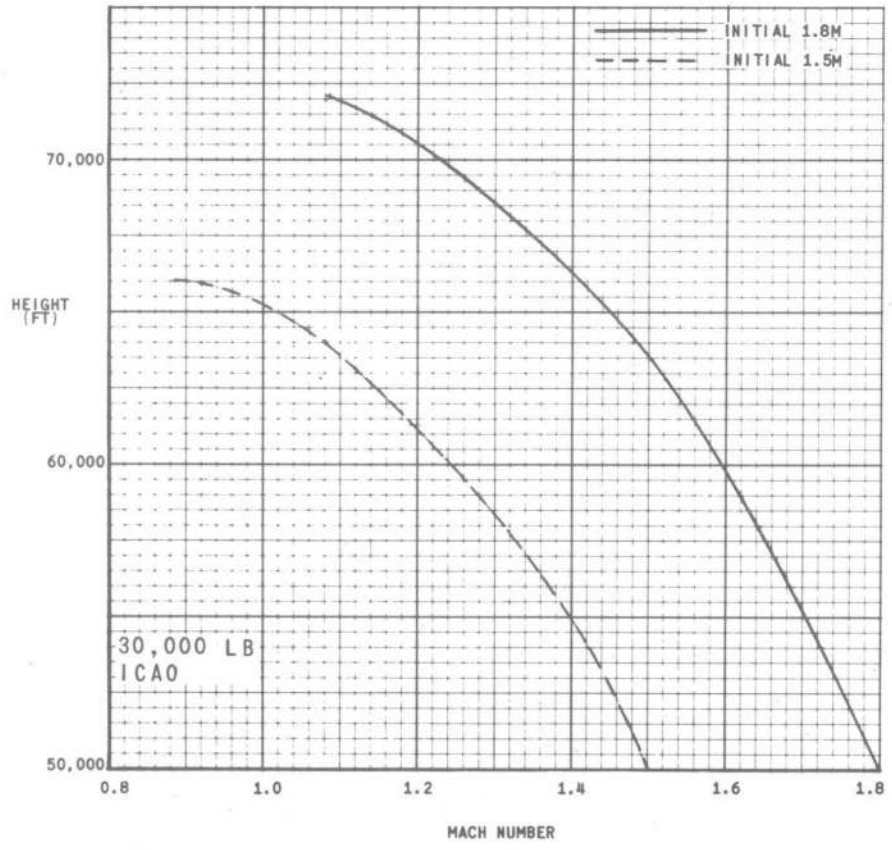
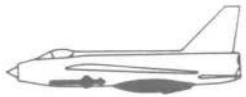
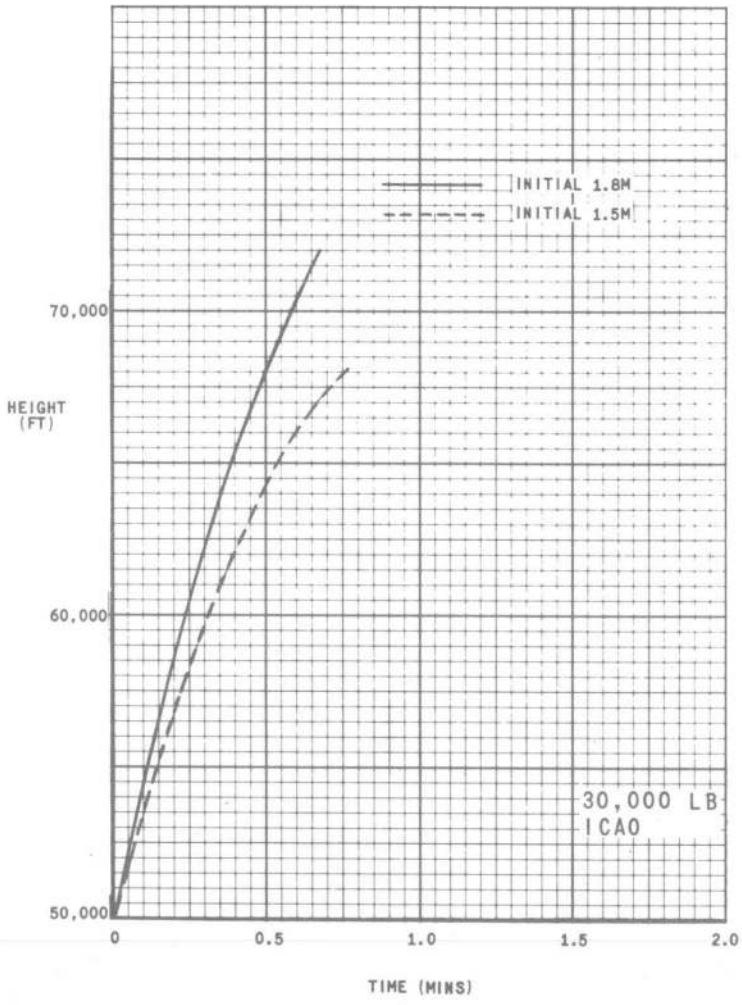


FIG. 3·25. CLIMB AT CONSTANT A/C ATTITUDE $\theta = 20^{o}$ FUEL AND MACH No.





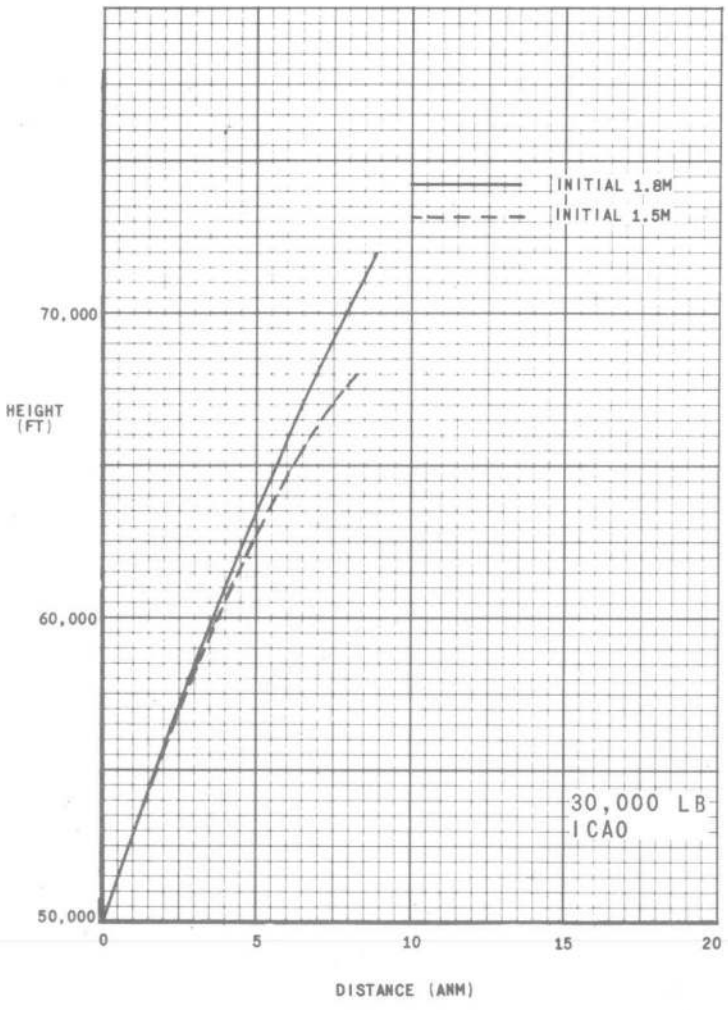
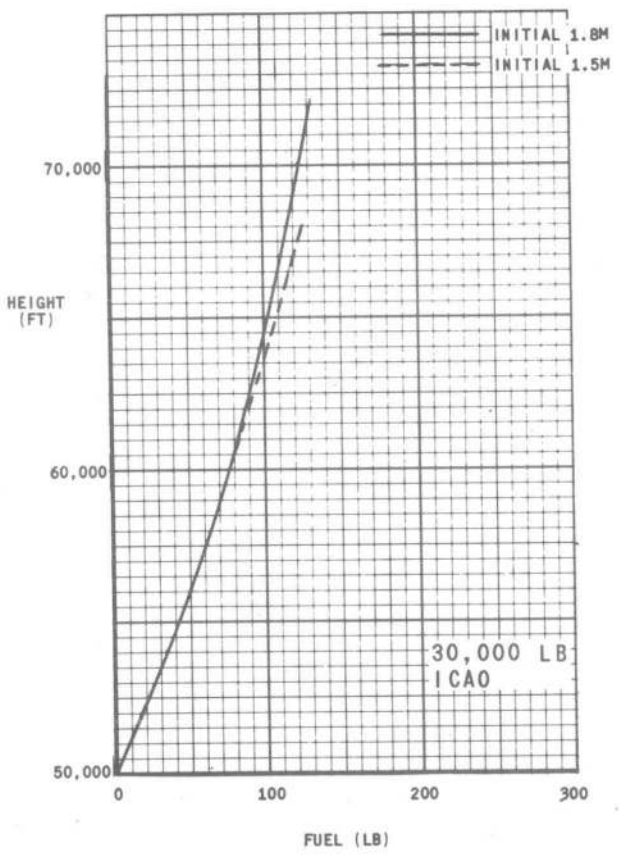


FIG. 3·26. CLIMB AT CONSTANT A/C ATTITUDE $\theta = 30^{o}$ TIME AND DISTANCE



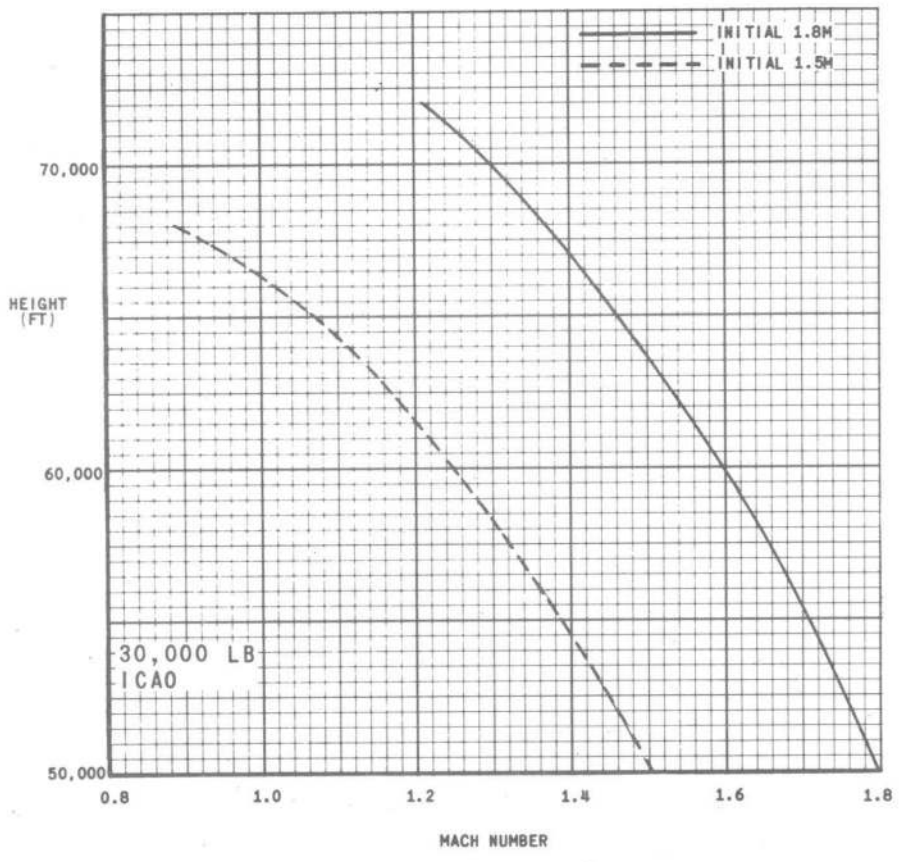
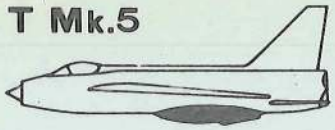
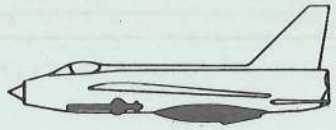
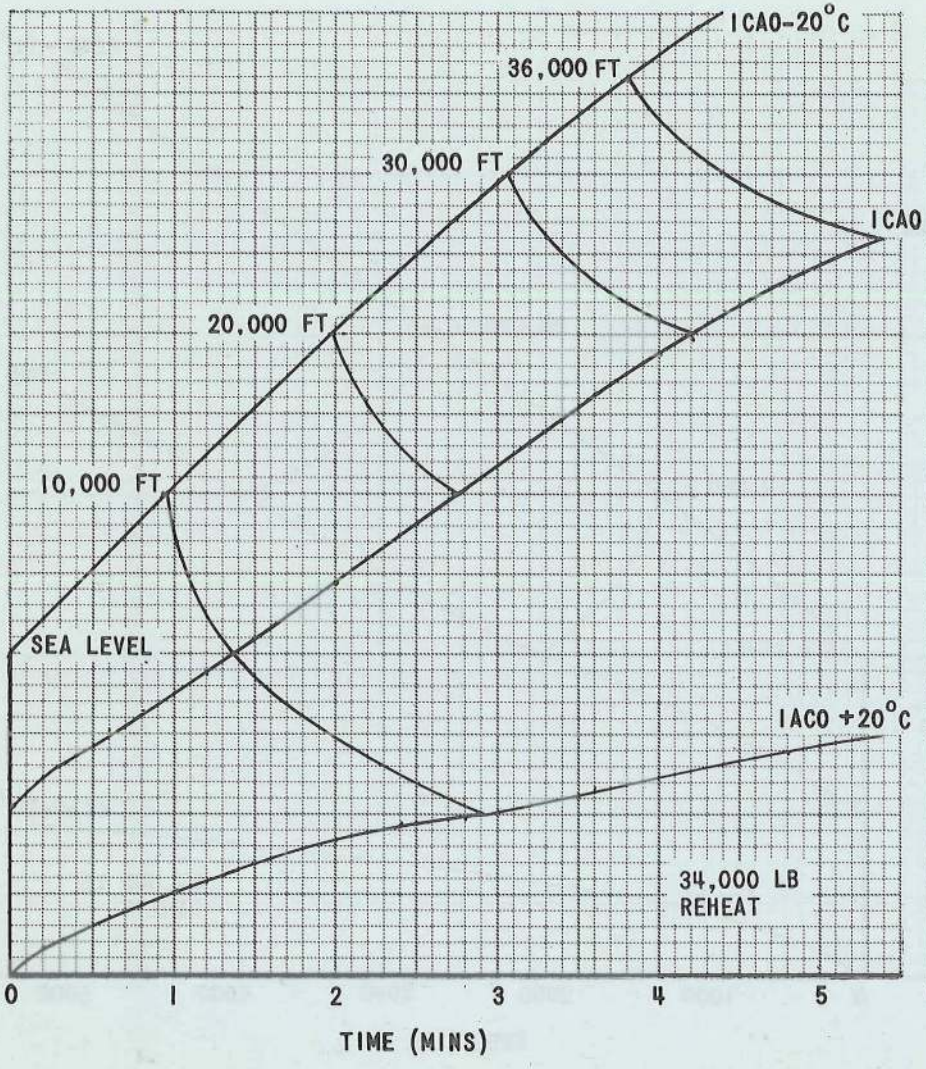


FIG. 3·27. CLIMB AT CONSTANT A/C ATTITUDE $\theta = 30^{o}$ FUEL AND MACH No.

T Mk.5







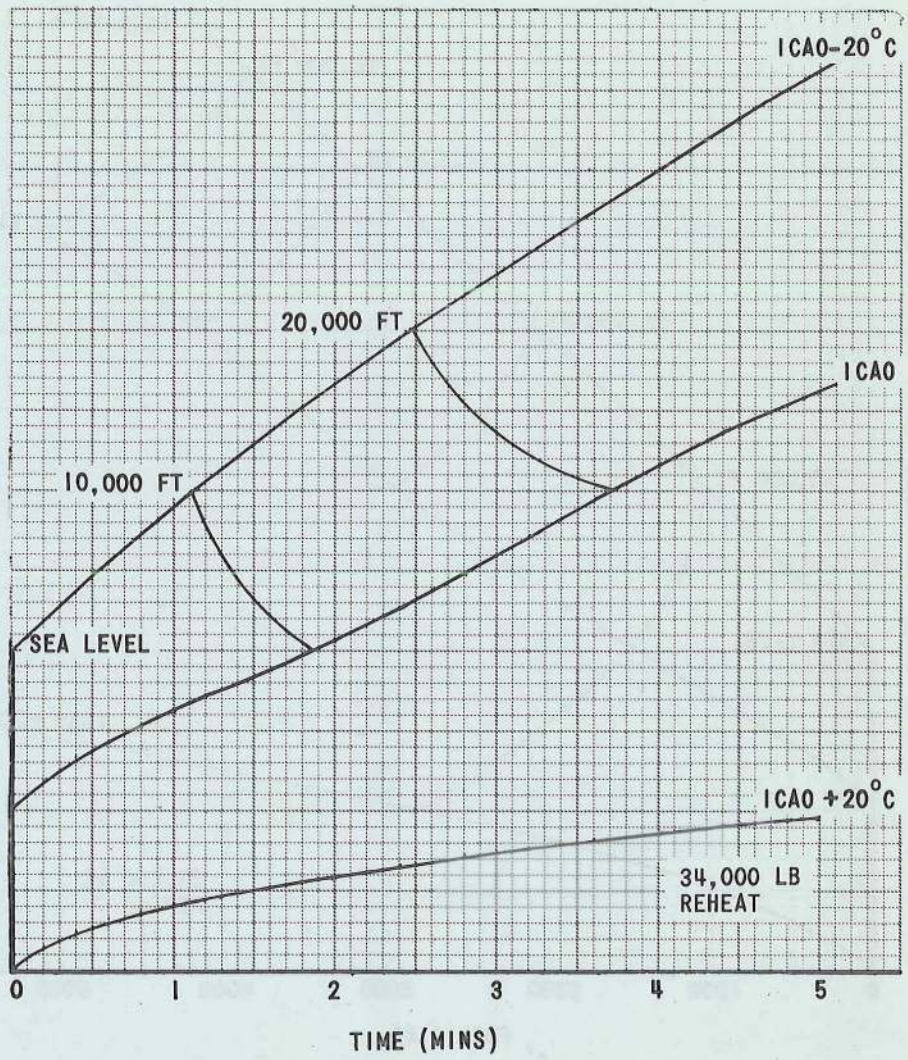
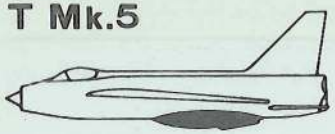
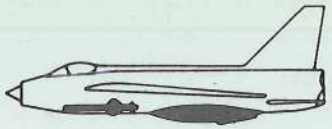
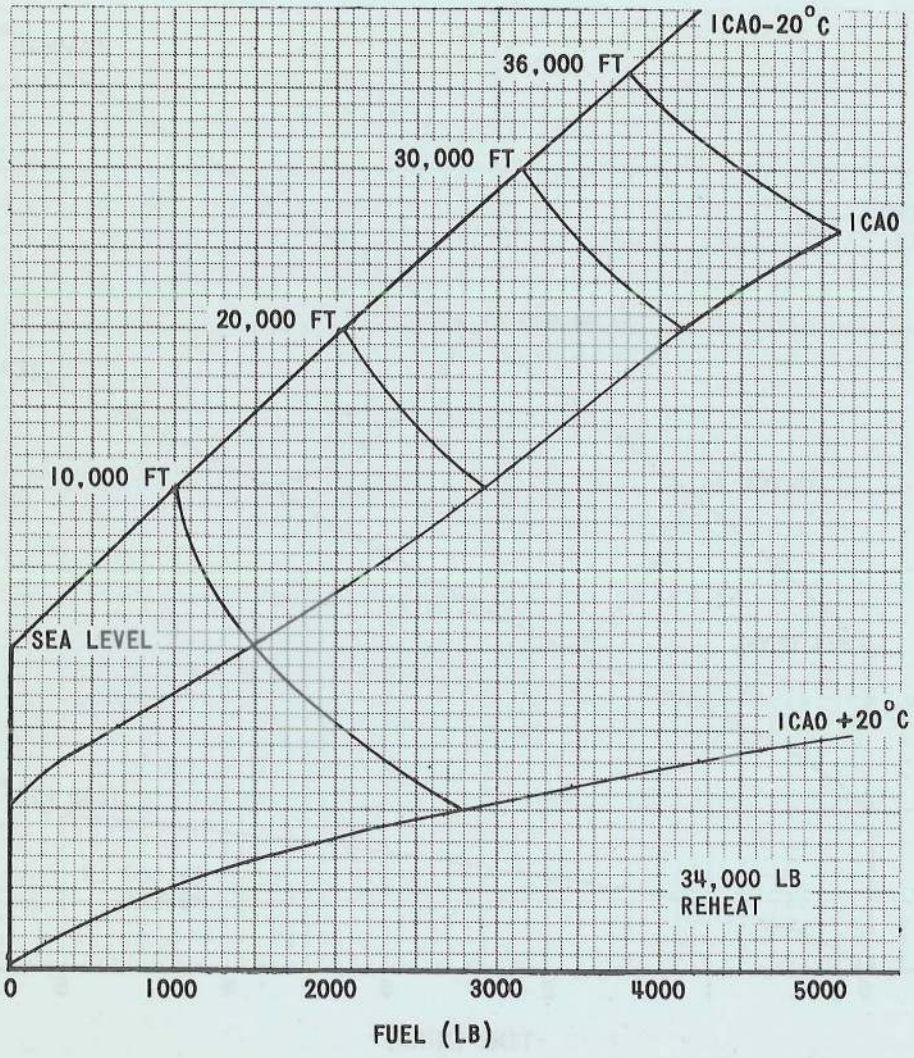


FIG. 3.1 CLIMB AT 650K IN TROPOSPHERE TIME TO ALTITUDE

T Mk.5







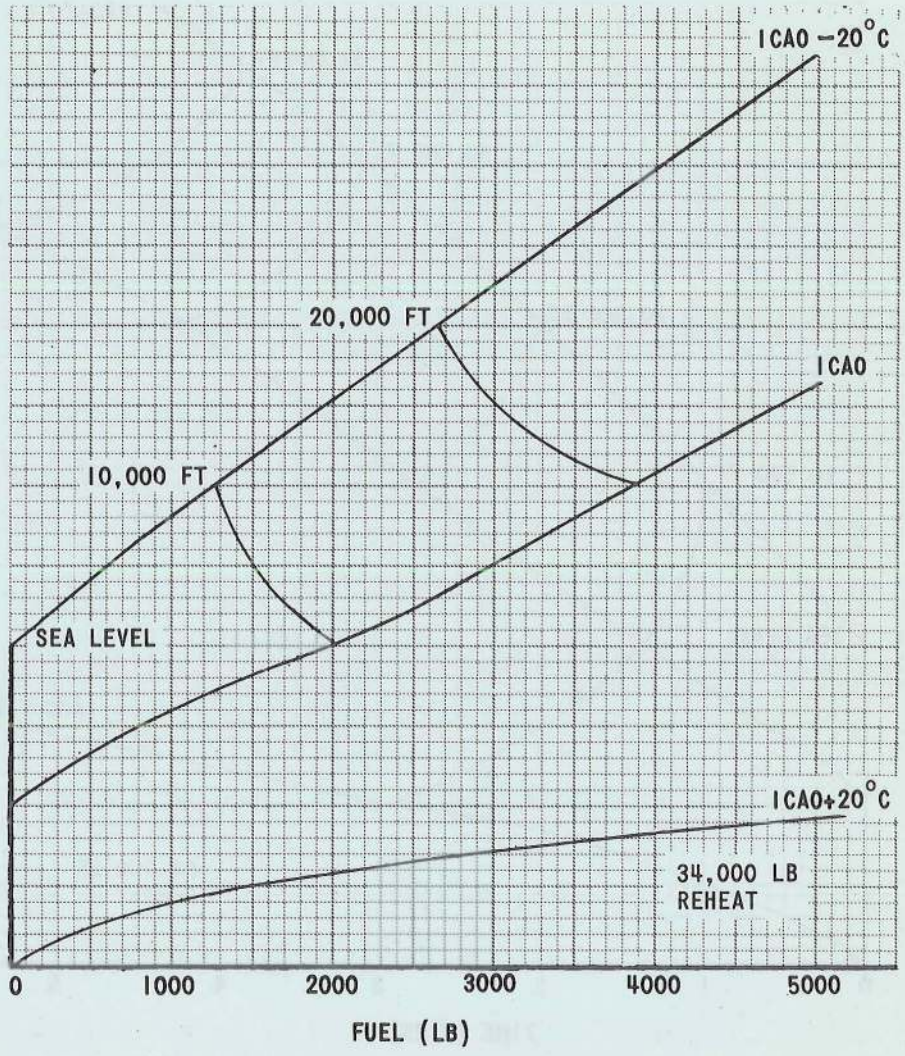
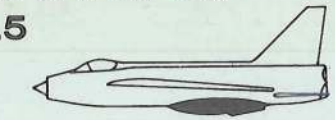
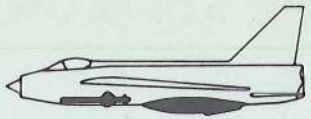
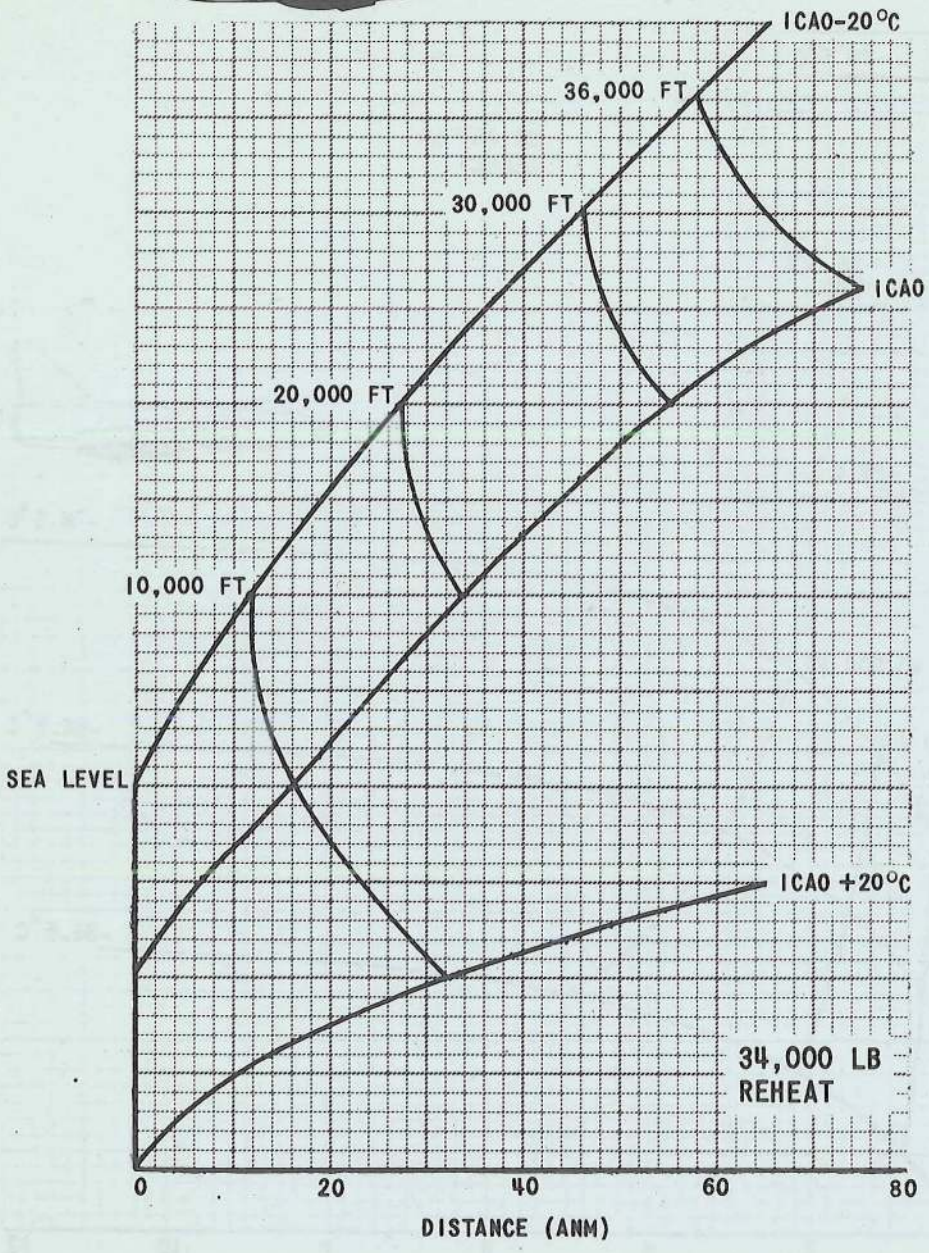


FIG. 3.2 CLIMB AT 650K IN TROPOSPHERE FUEL TO ALTITUDE







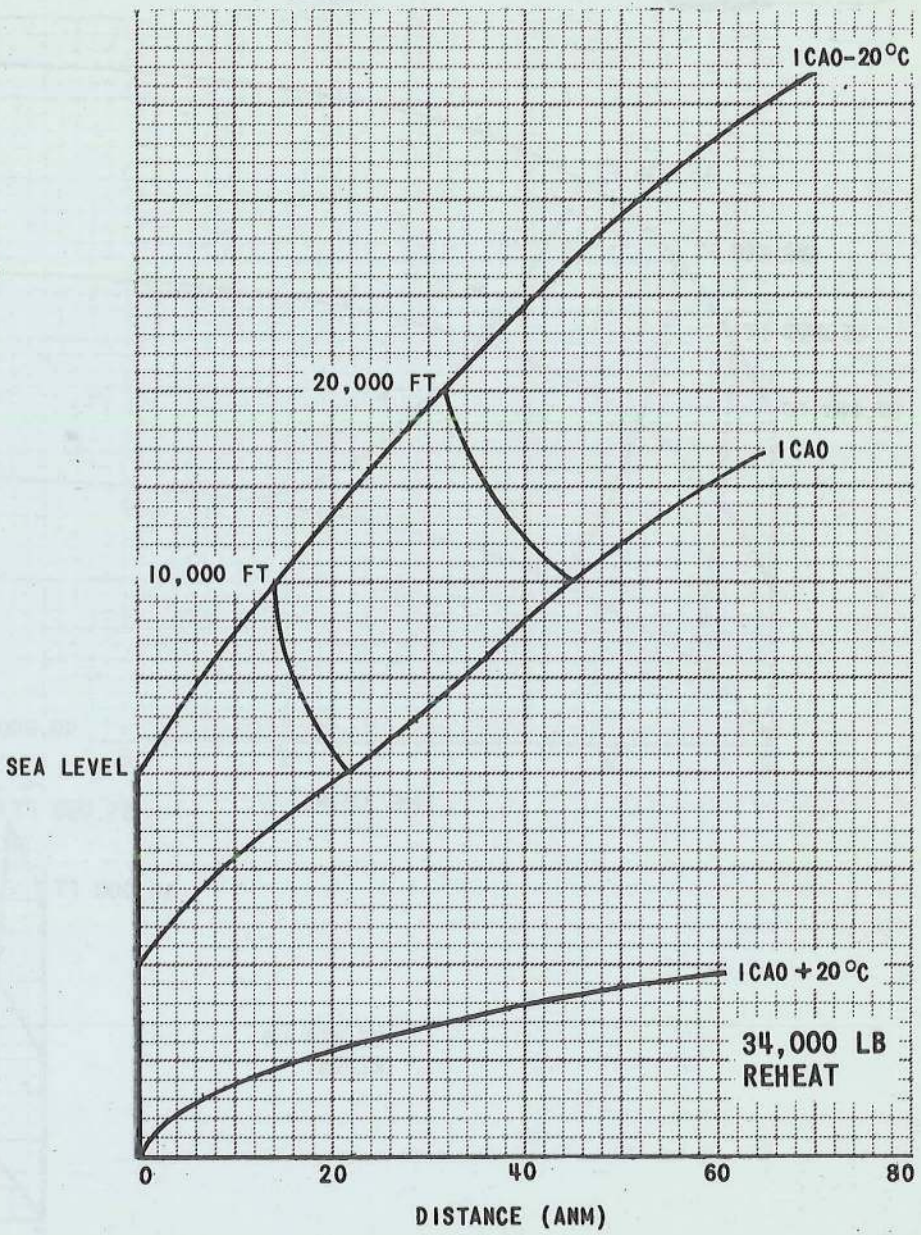
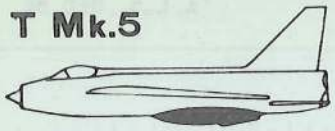


FIG. 3.3 CLIMB AT 650K IN TROPOSPHERE DISTANCE TO ALTITUDE



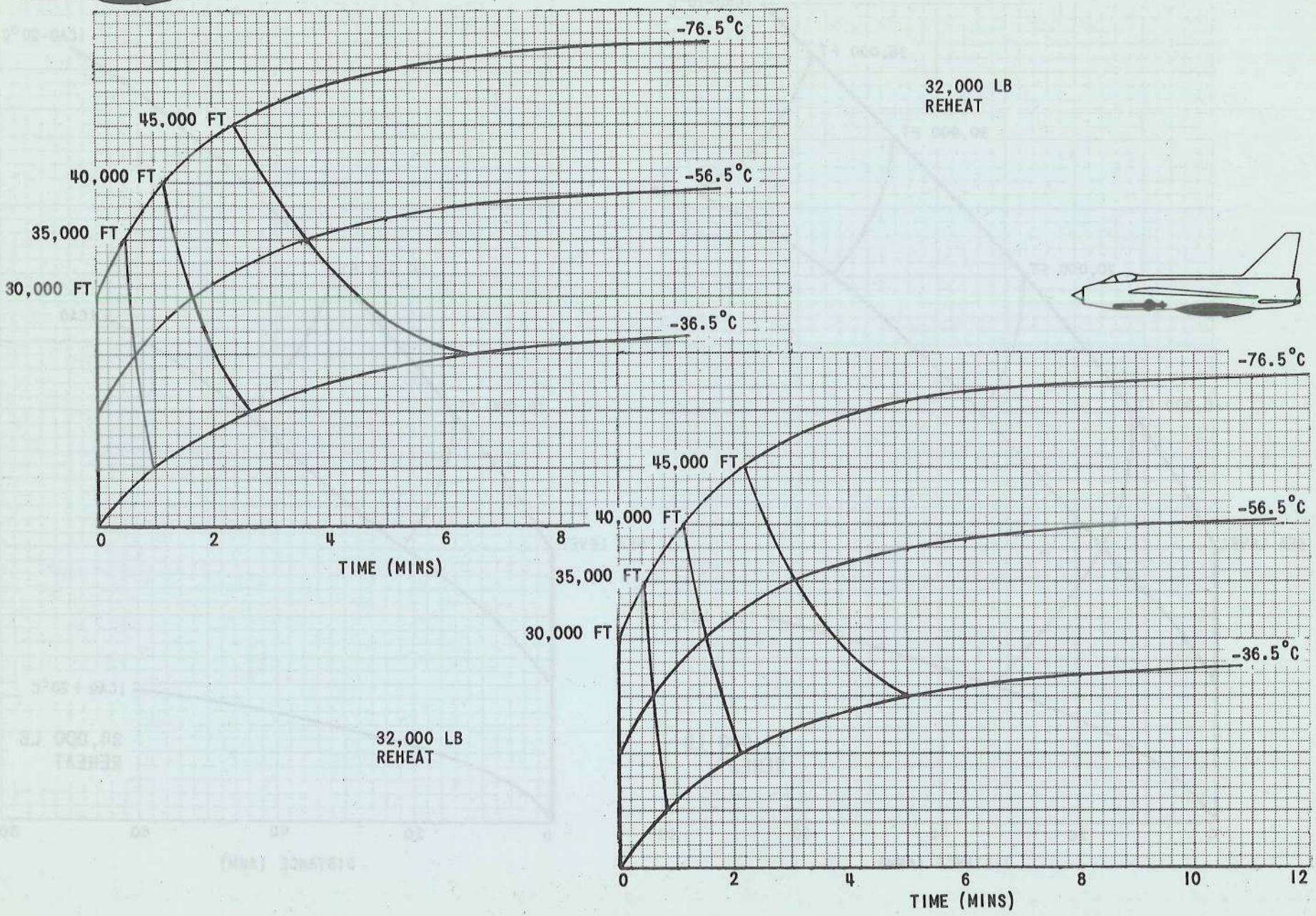
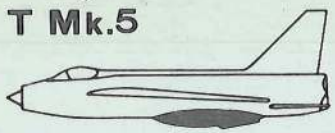
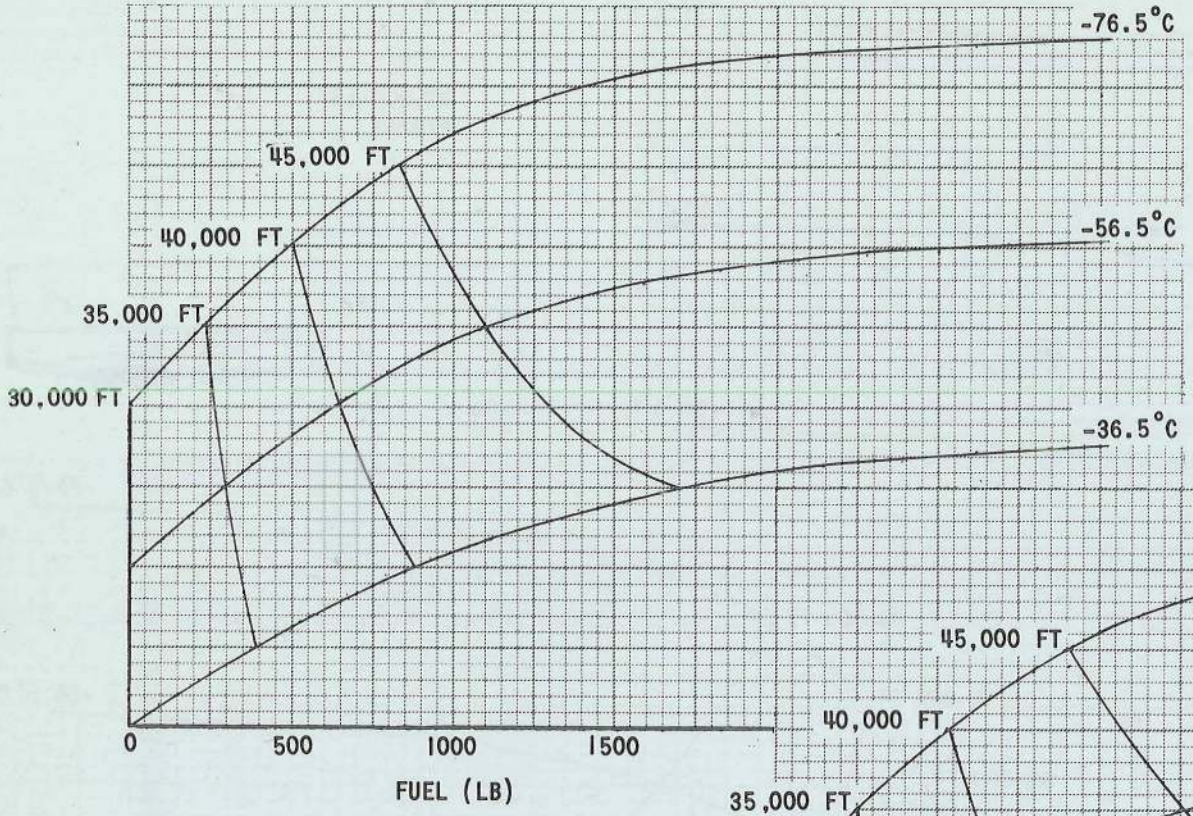
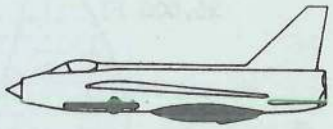


FIG. 3.4 CLIMB AT 1.1M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE







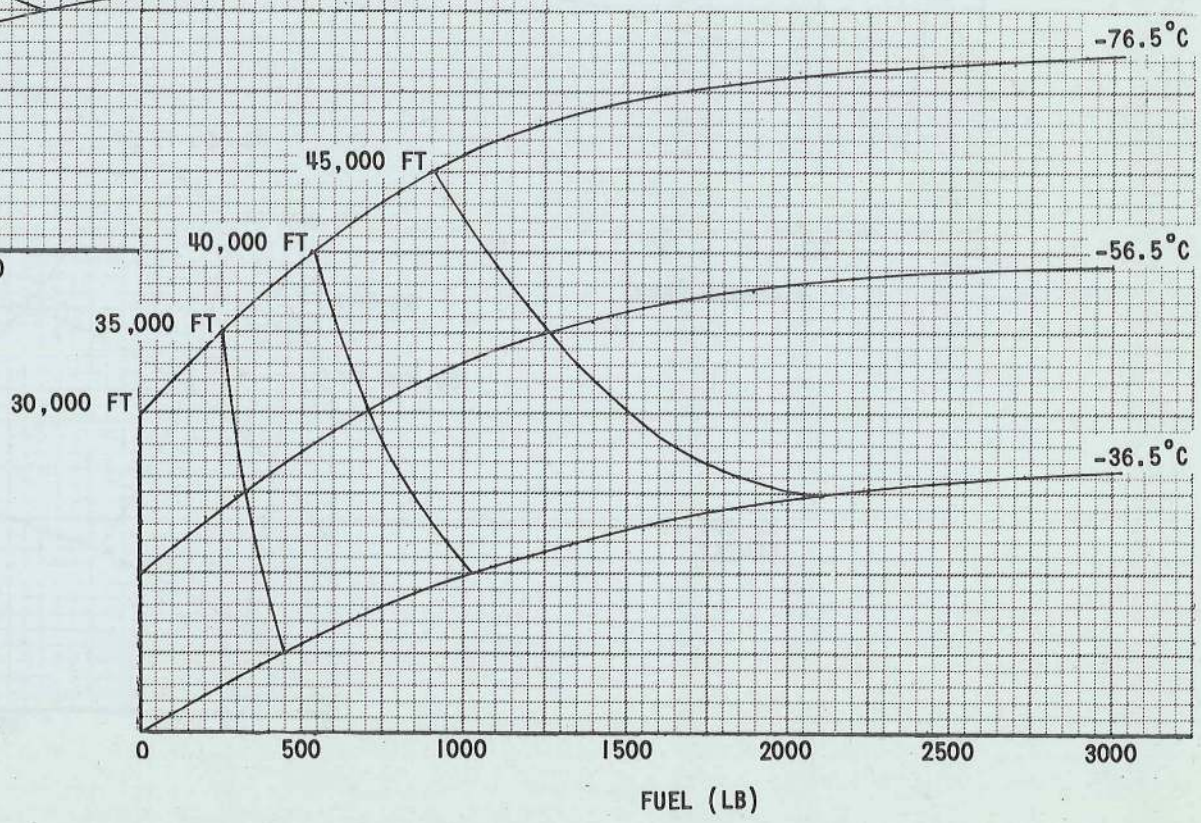
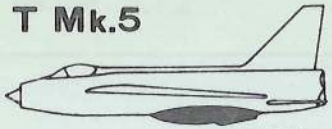
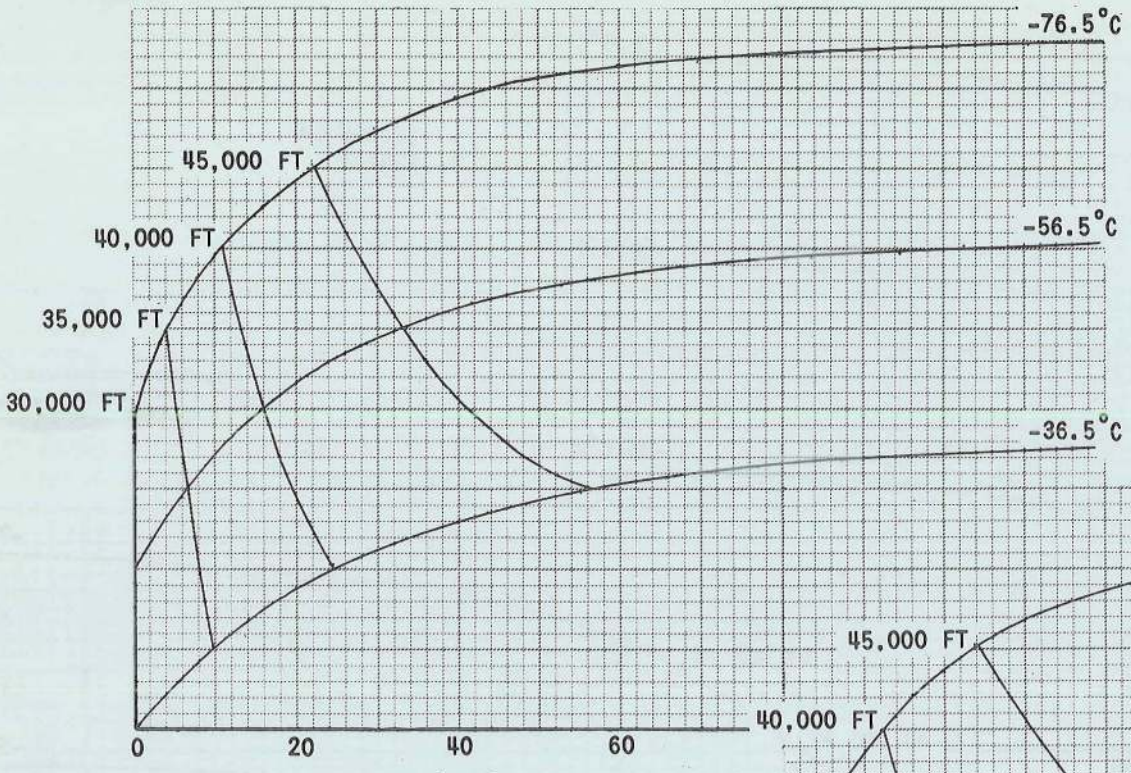


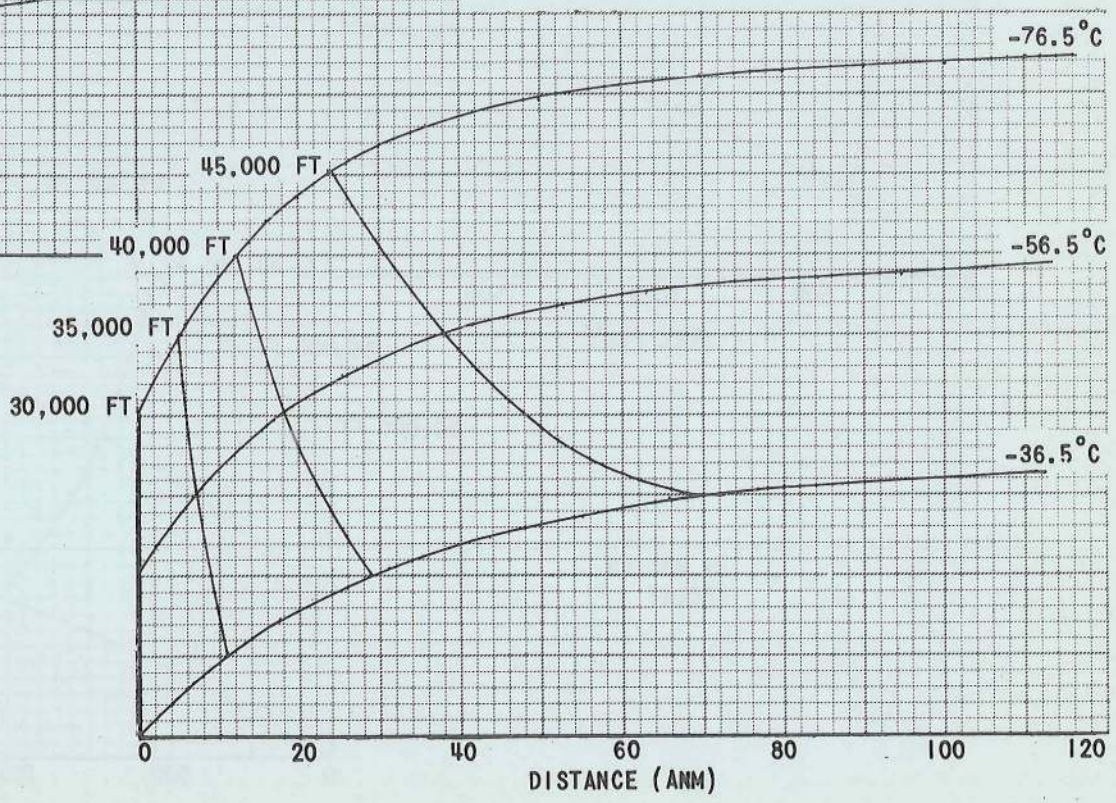
FIG. 3.5 CLIMB AT 1.1M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

T Mk.5



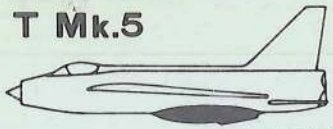


32,000 LB
REHEAT



32,000 LB
REHEAT

FIG. 3.6 CLIMB AT 1.1M IN ISOTHERMAL ATMOSPHERE DISTANCE TO ALTITUDE



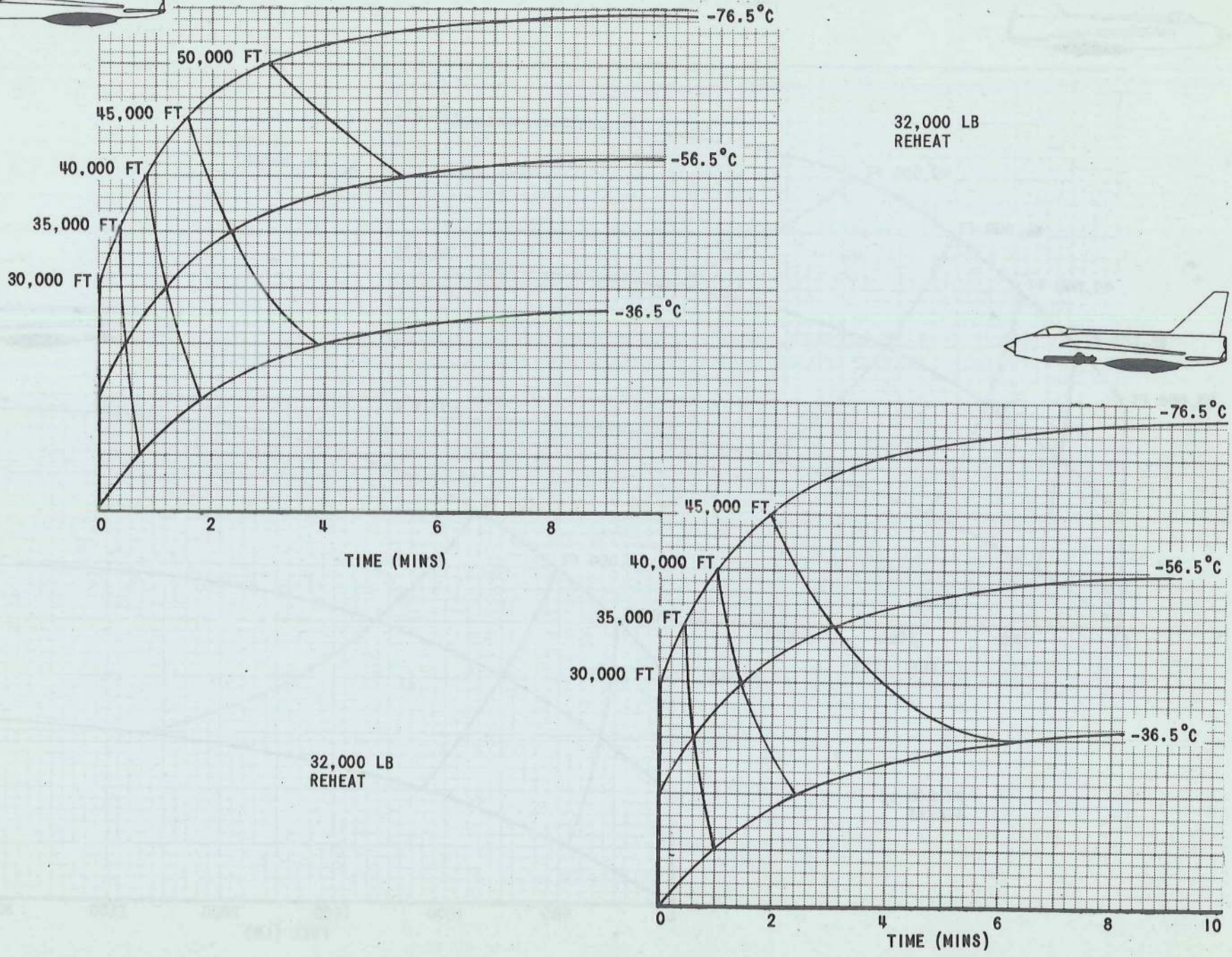
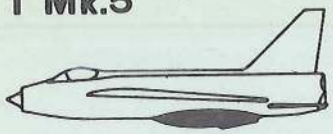


FIG. 3.7 CLIMB AT 1.3M IN ISOTHERMAL ATMOSPHERE TIME TO ALTITUDE

T Mk.5



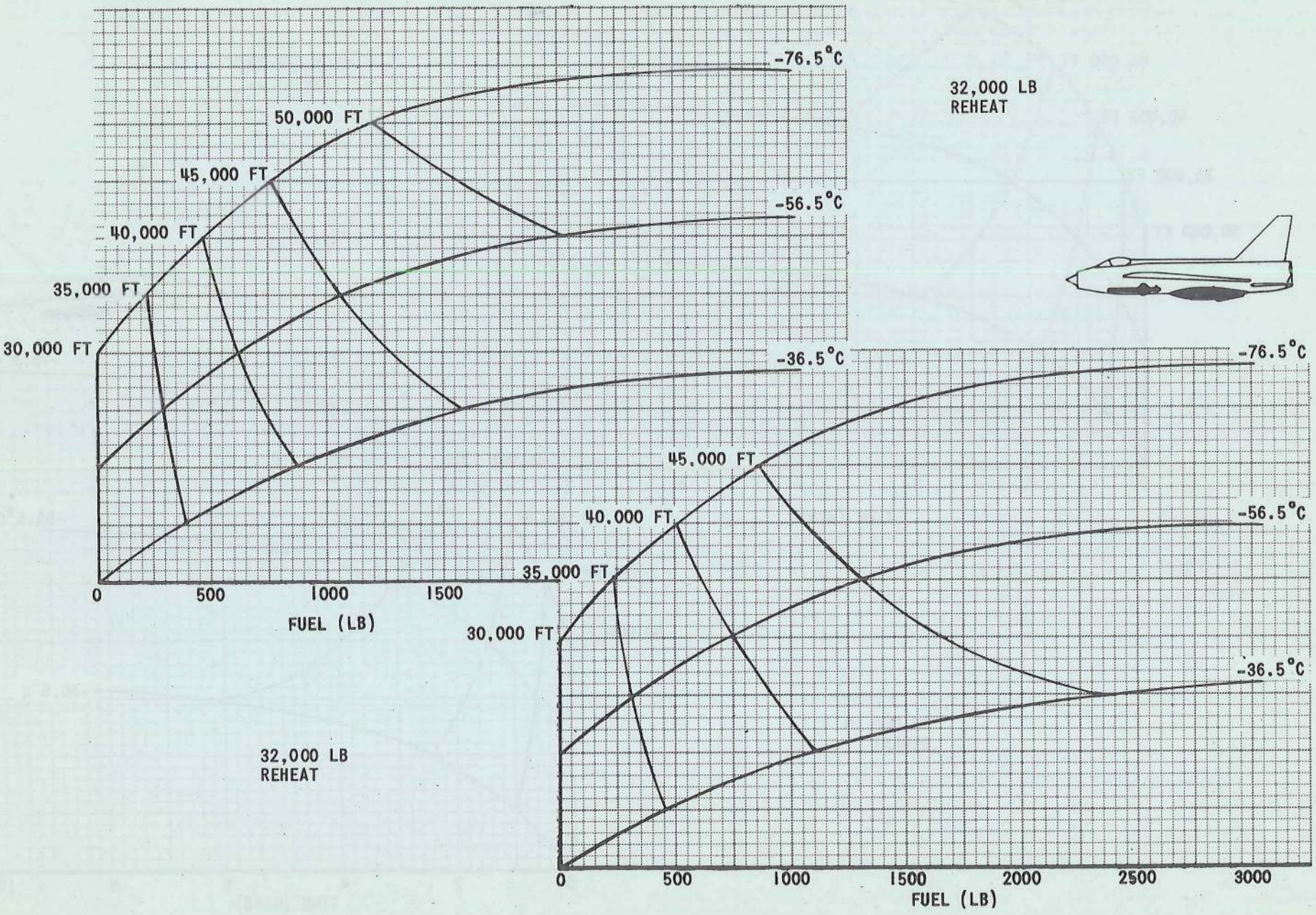
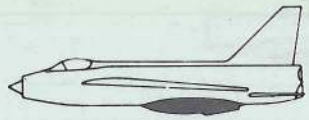
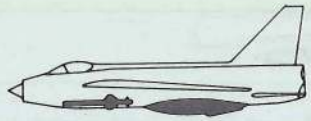
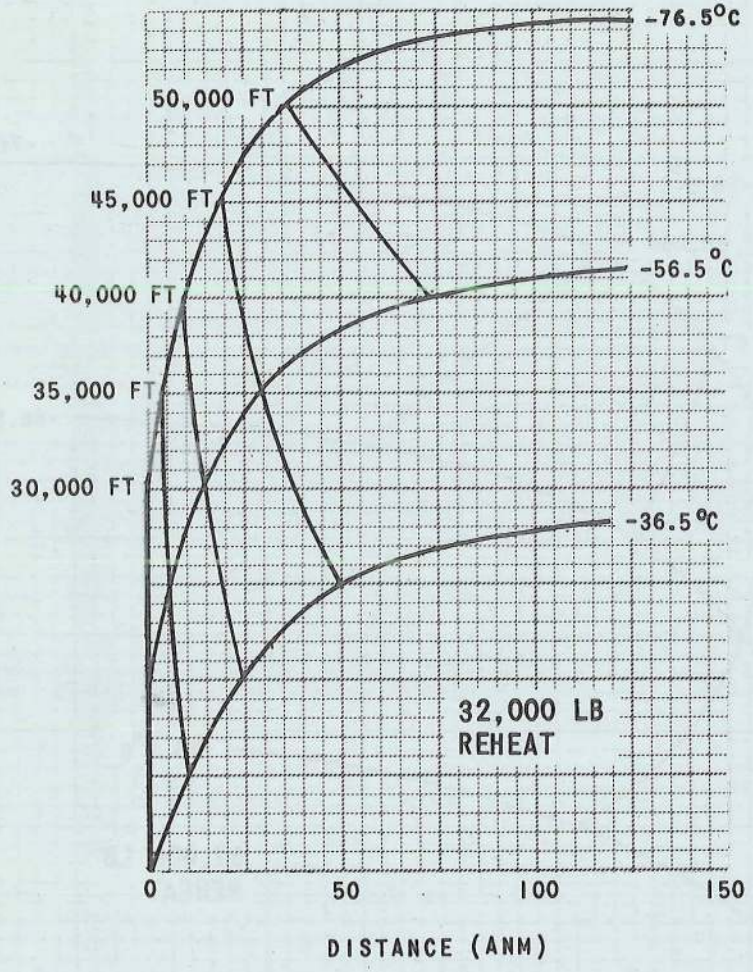


FIG. 3.8 CLIMB AT 1.3M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

T Mk.5







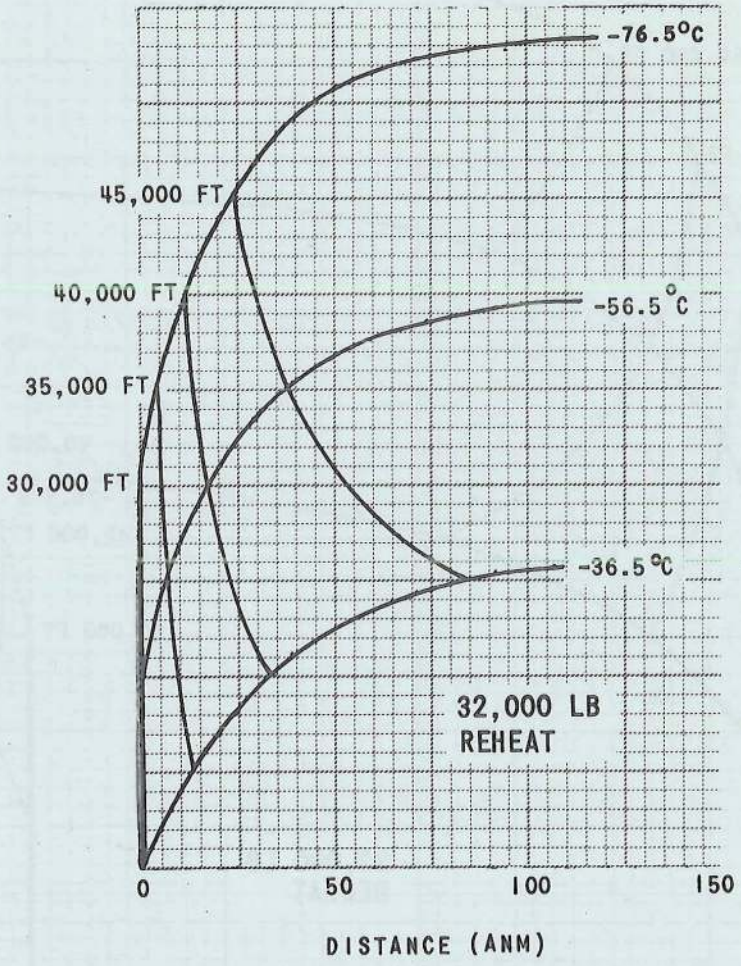
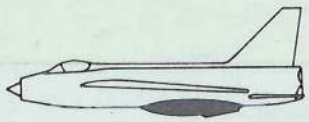
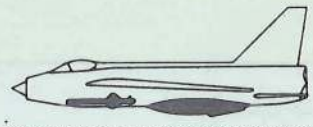


FIG. 3.9 CLIMB AT 1·3M IN ISOTHERMAL ATMOSPHERE
DISTANCE TO ALTITUDE





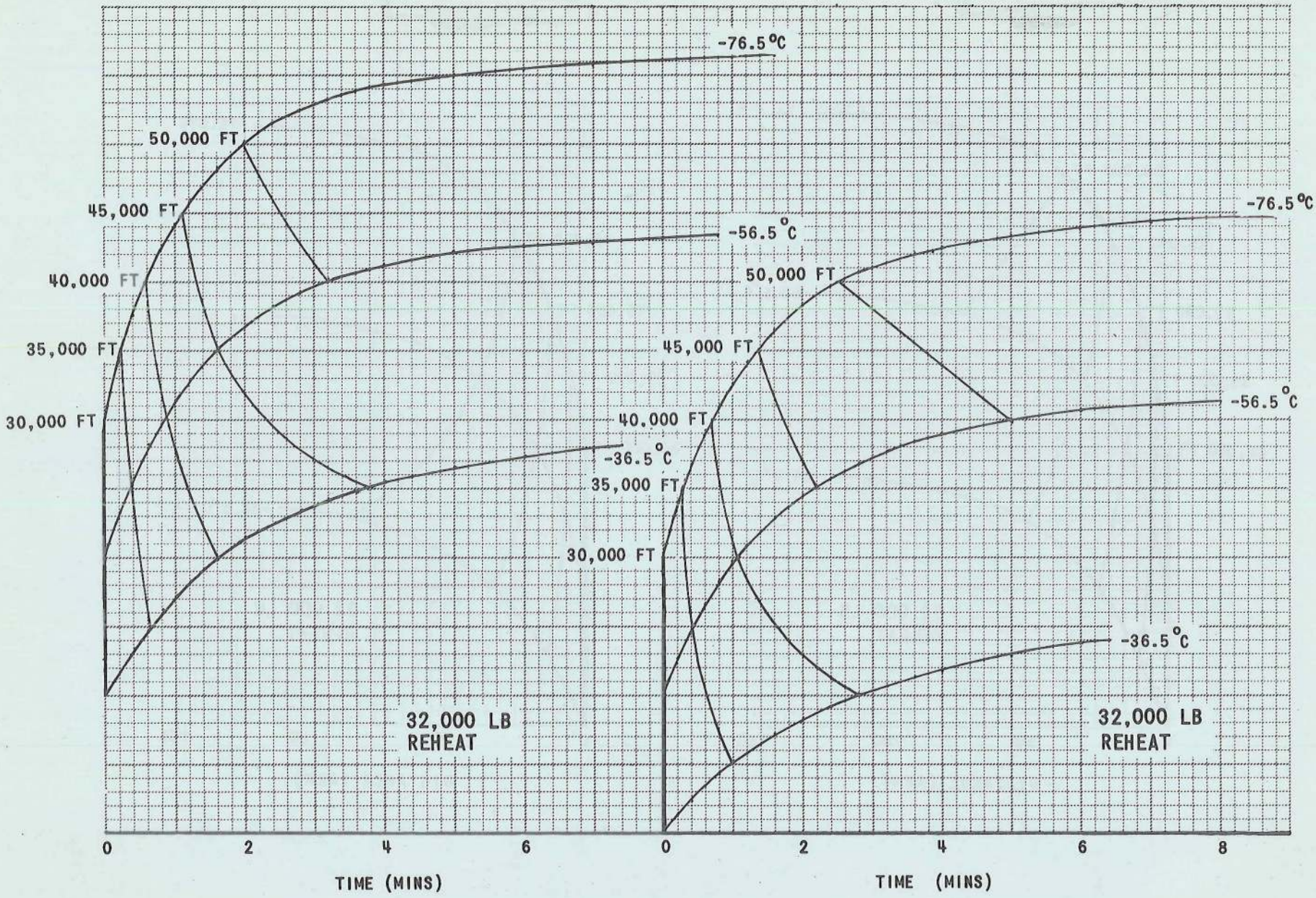
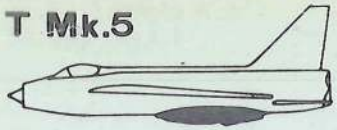


FIG. 3.10 CLIMB AT 1·5M IN ISOTHERMAL ATMOSPHERE
TIME TO ALTITUDE



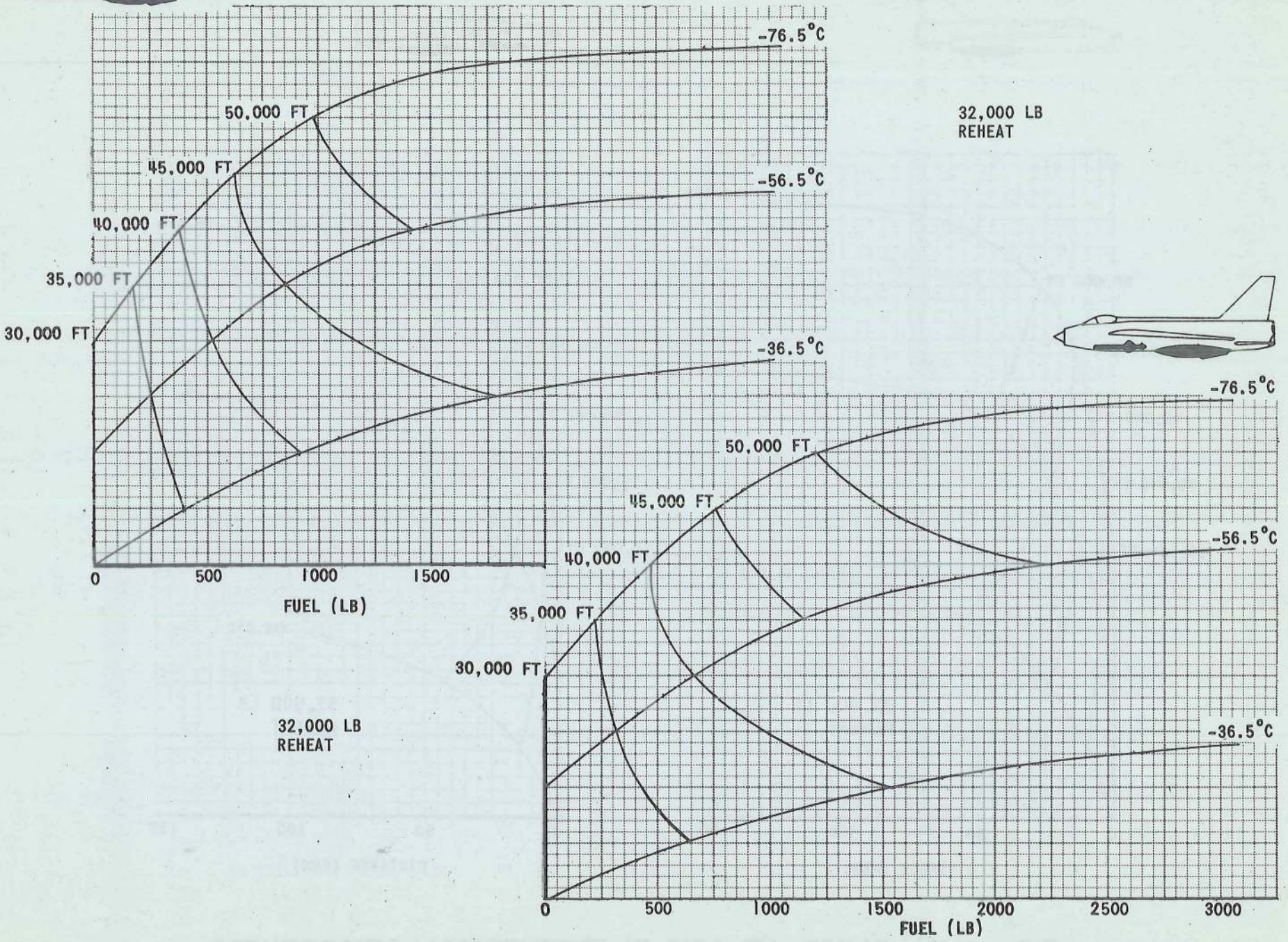
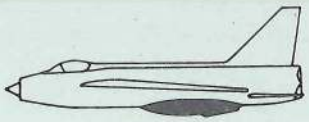
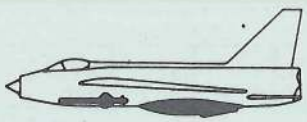
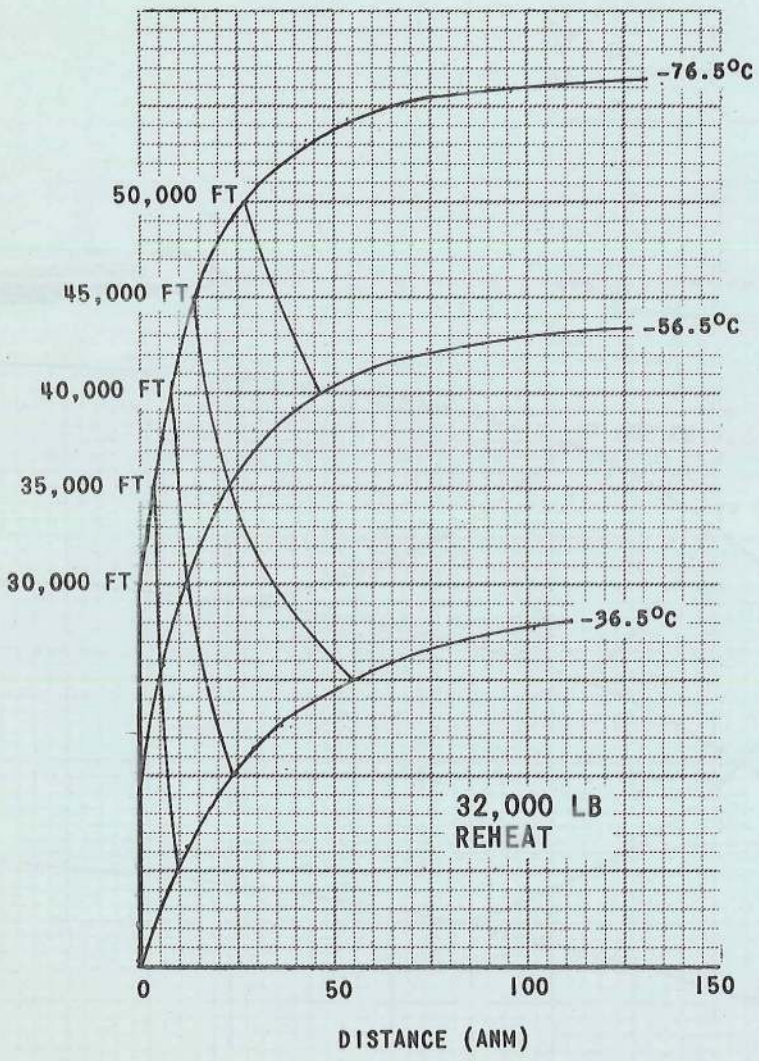


FIG. 3.11 CLIMB AT 1.5M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE

T Mk.5







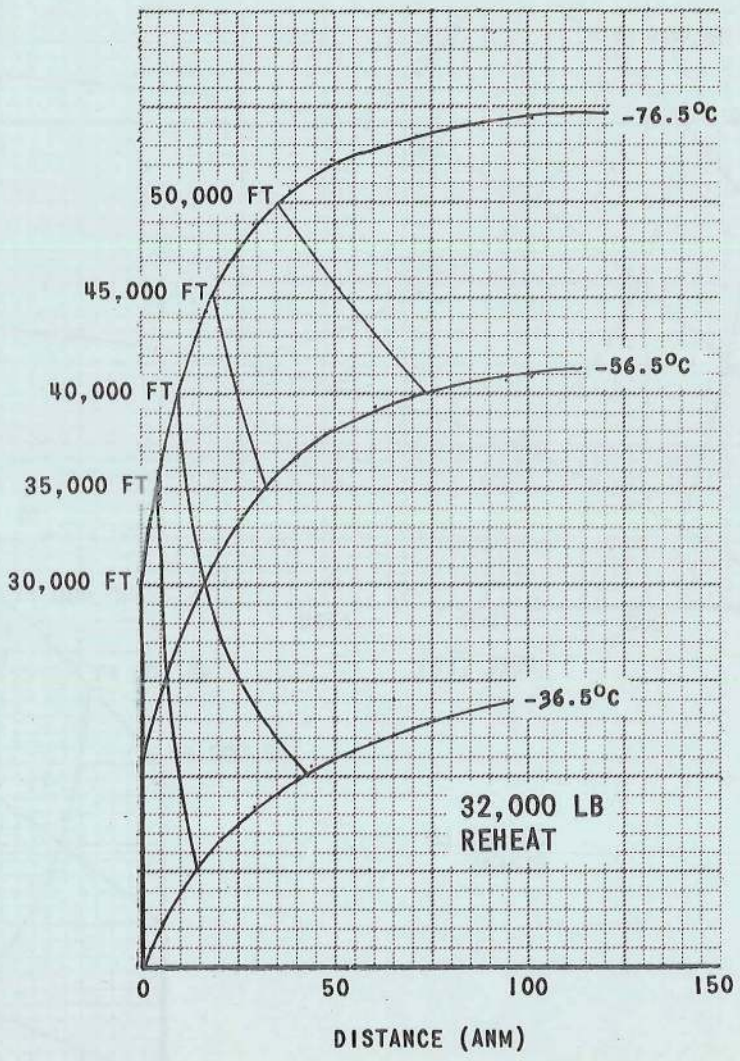
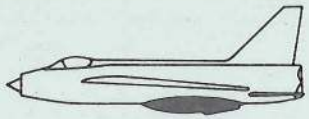
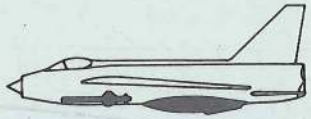
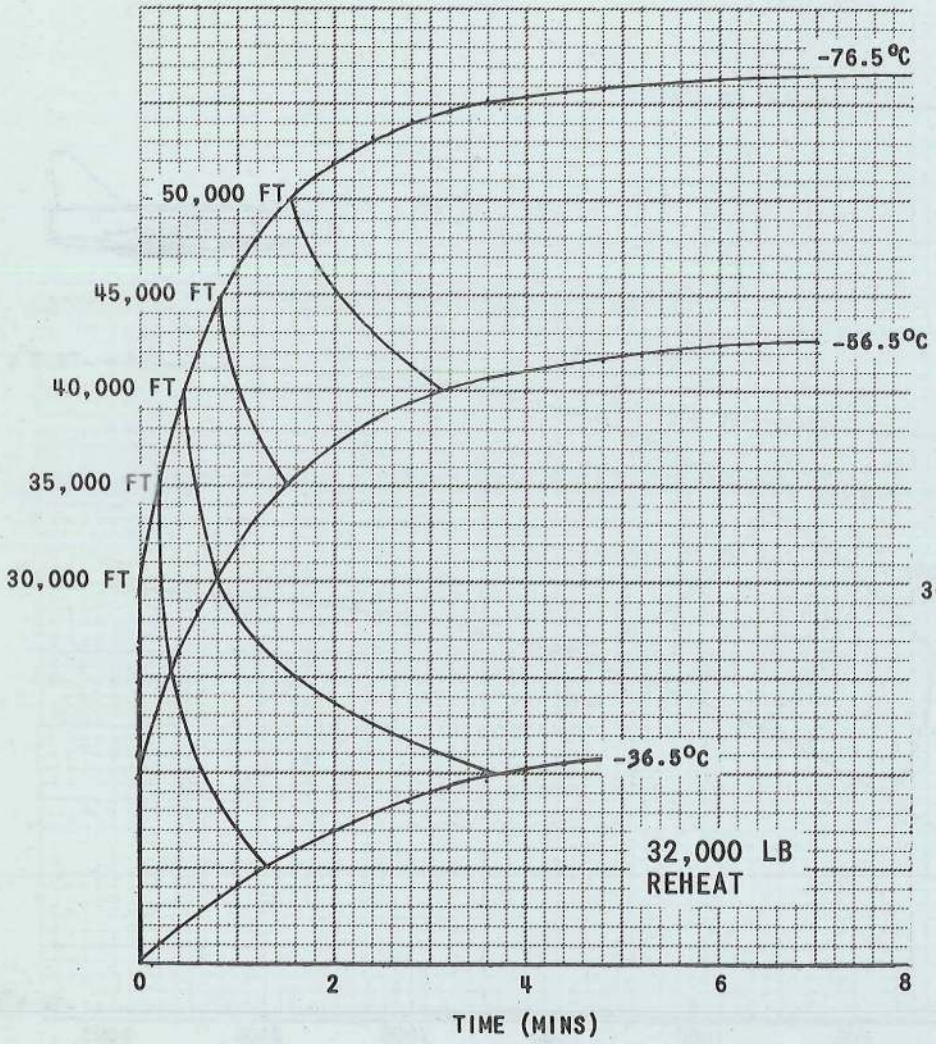


FIG. 3.12 CLIMB AT 1·5M IN ISOTHERMAL ATMOSPHERE
DISTANCE TO ALTITUDE







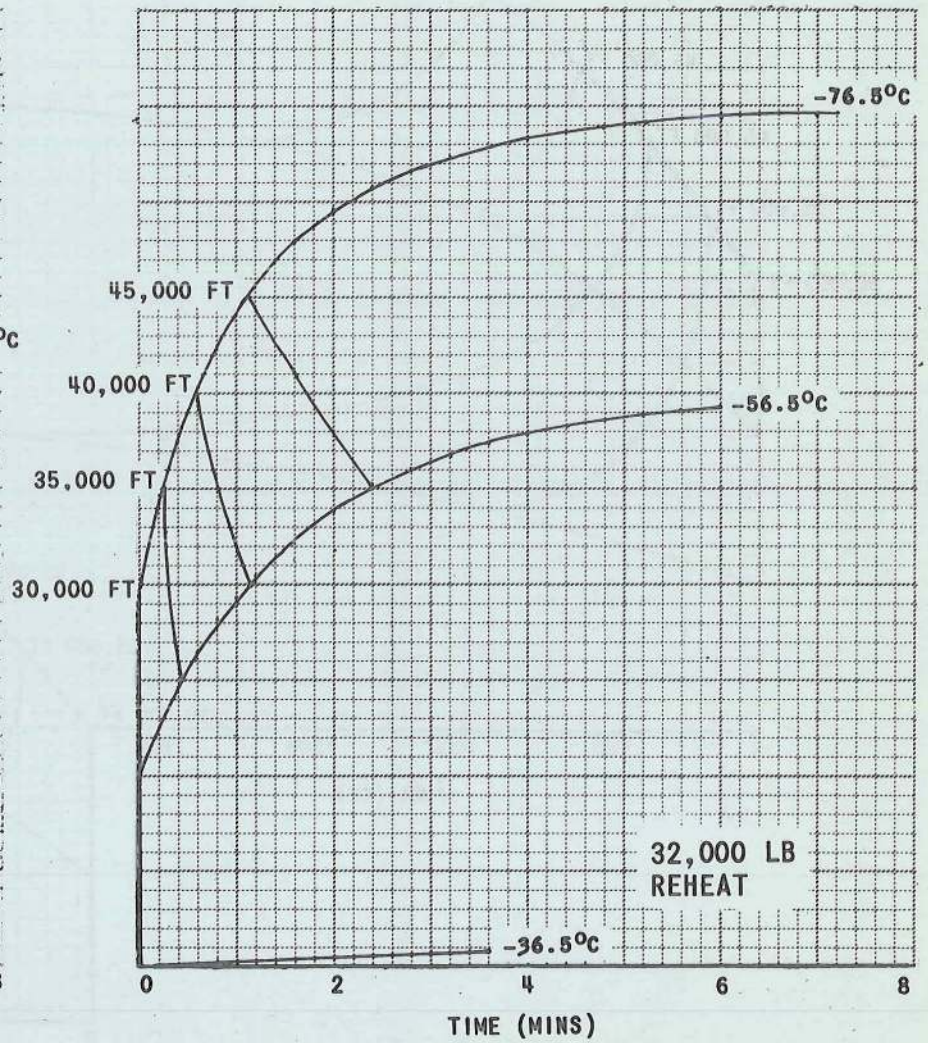
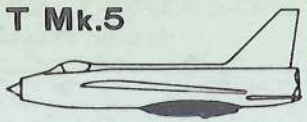


FIG. 3.13 CLIMB AT 1·7M IN ISOTHERMAL ATMOSPHERE
TIME TO ALTITUDE



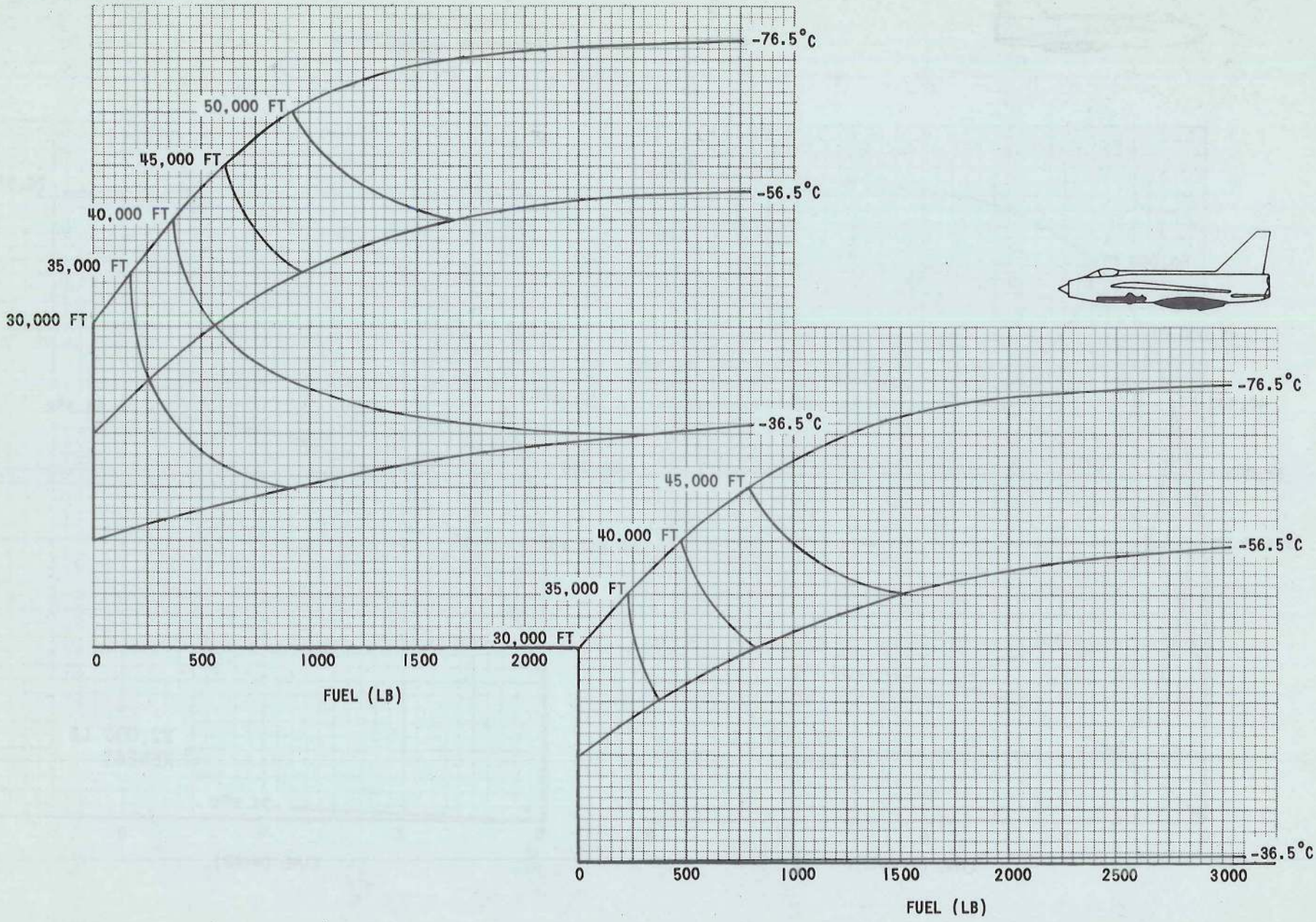
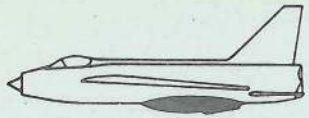
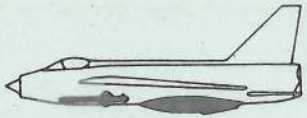
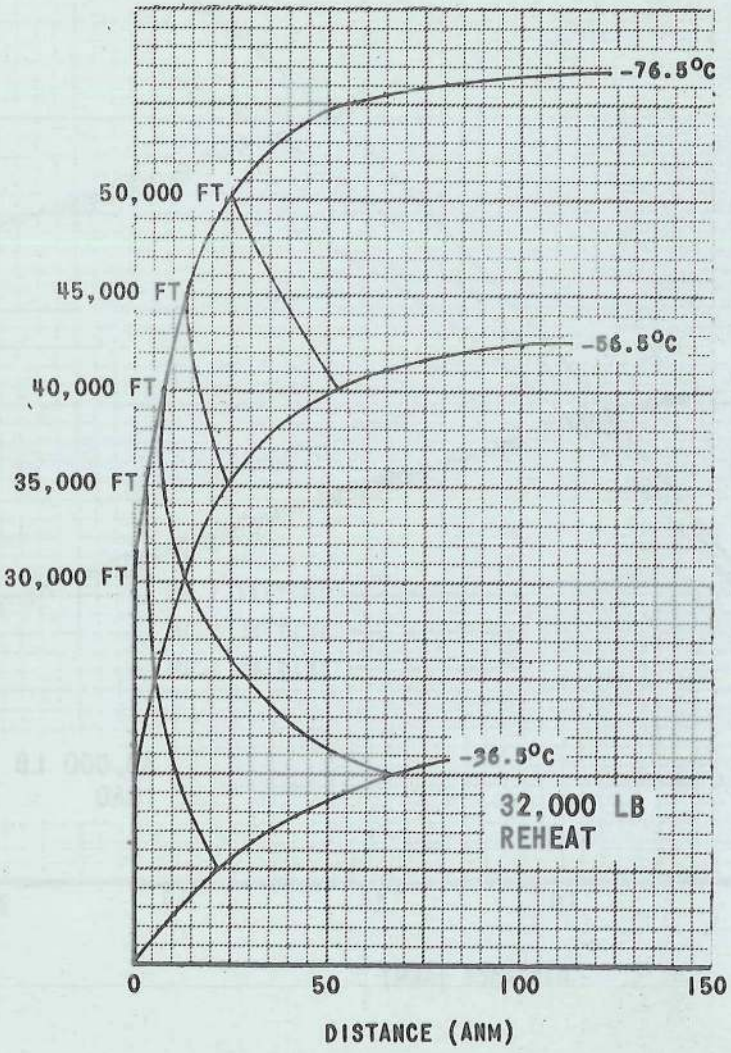


FIG. 3.14 CLIMB AT 1.7M IN ISOTHERMAL ATMOSPHERE FUEL TO ALTITUDE







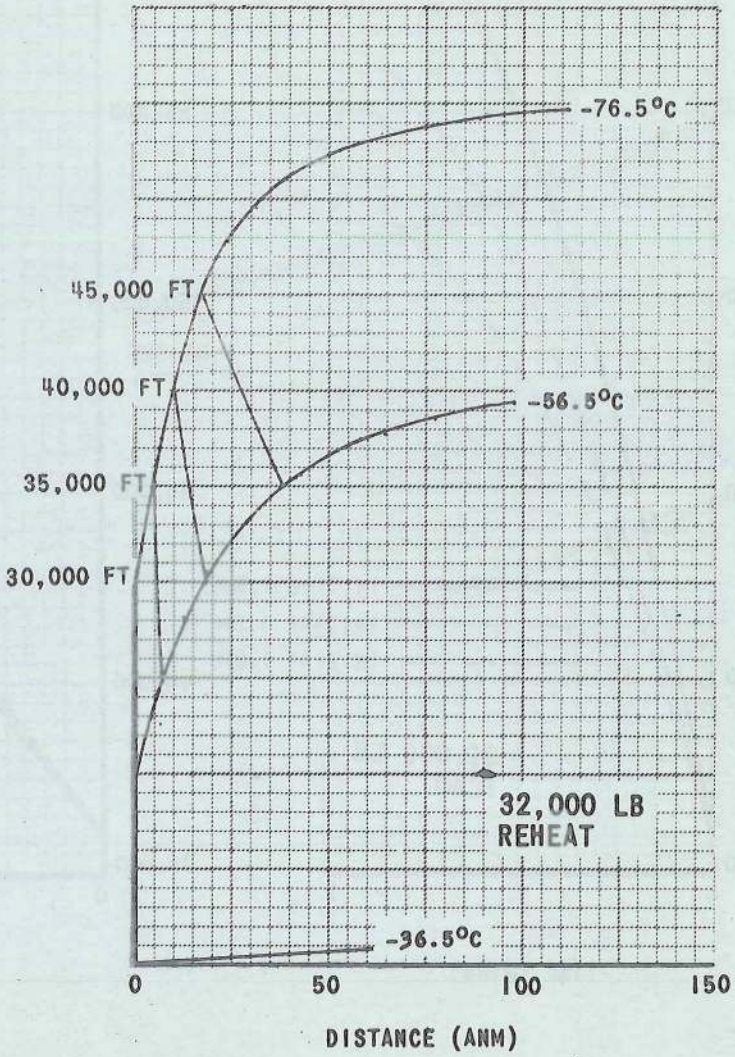
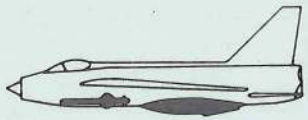
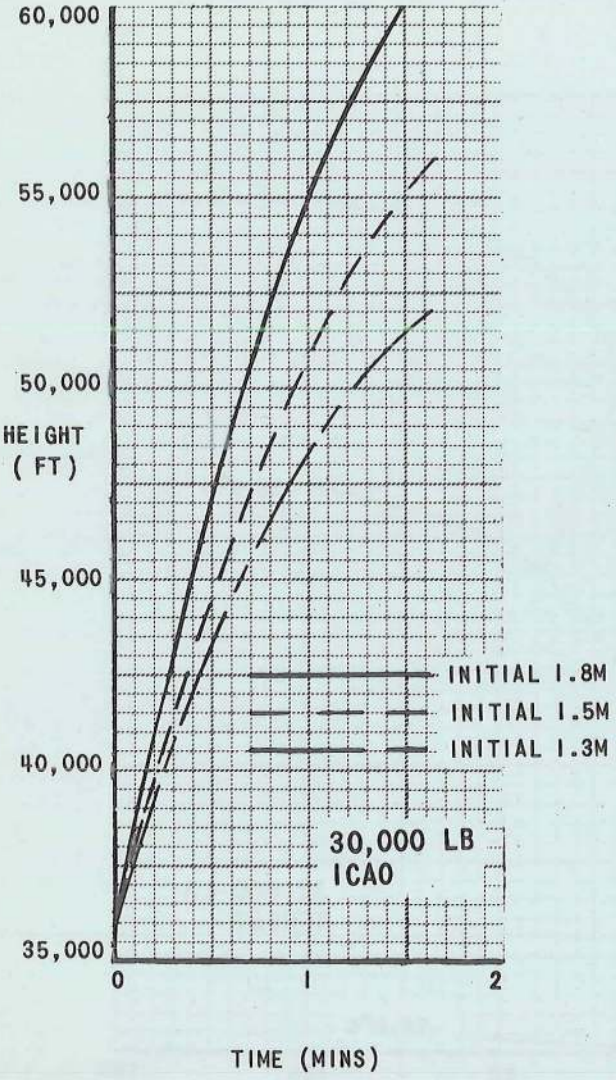


FIG. 3.15 CLIMB AT 1·7M IN ISOTHERMAL ATMOSPHERE
DISTANCE TO ALTITUDE

T Mk.5





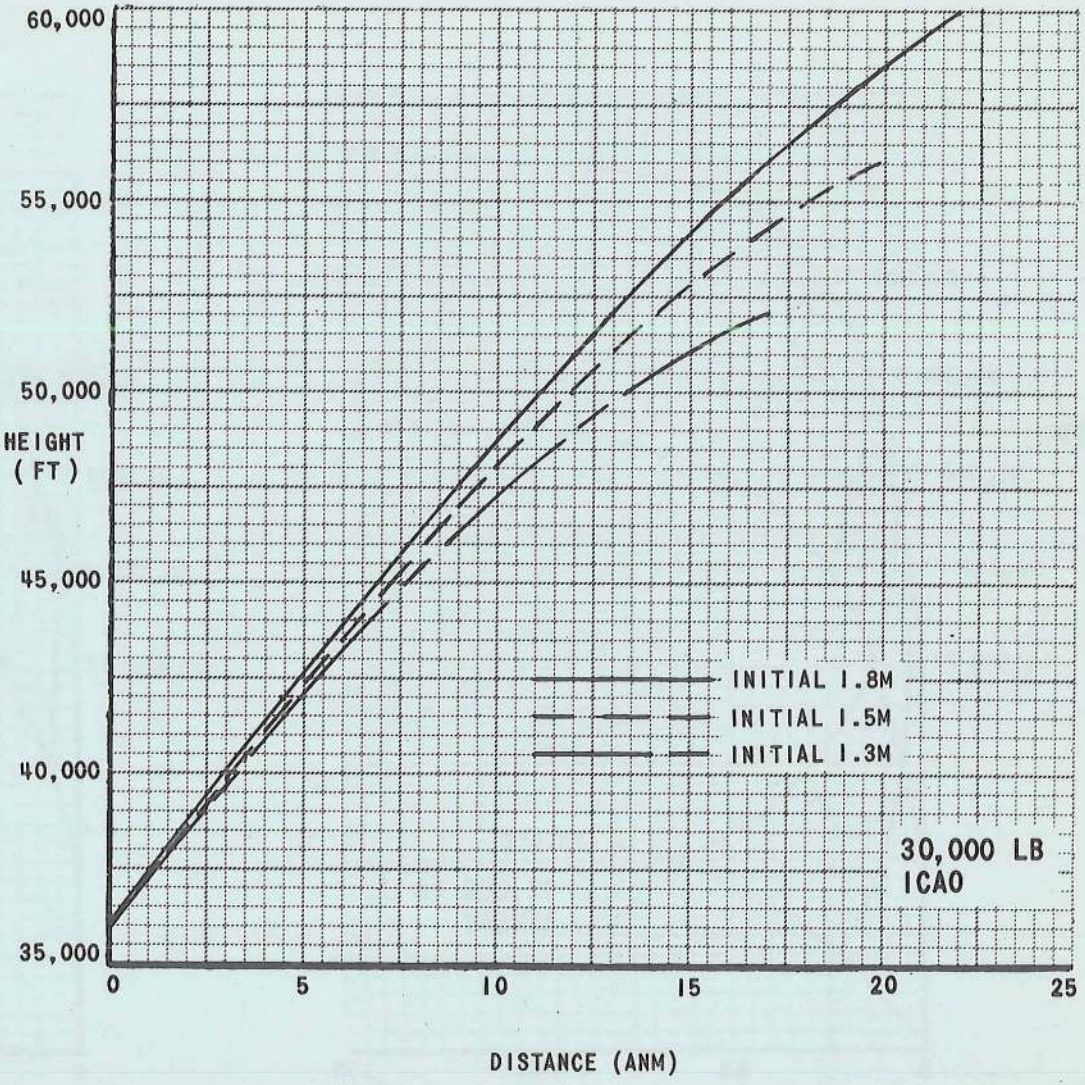
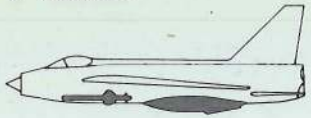
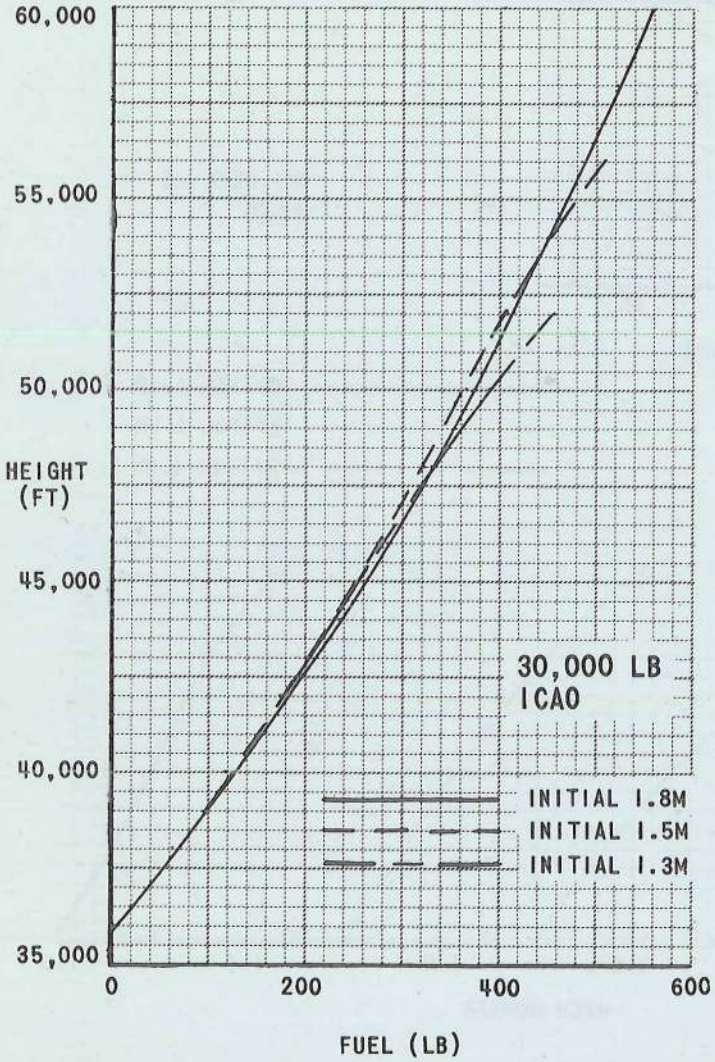


FIG. 3.16 CLIMB AT CONSTANT A/C ATTITUDE θ =15°
TIME AND DISTANCE





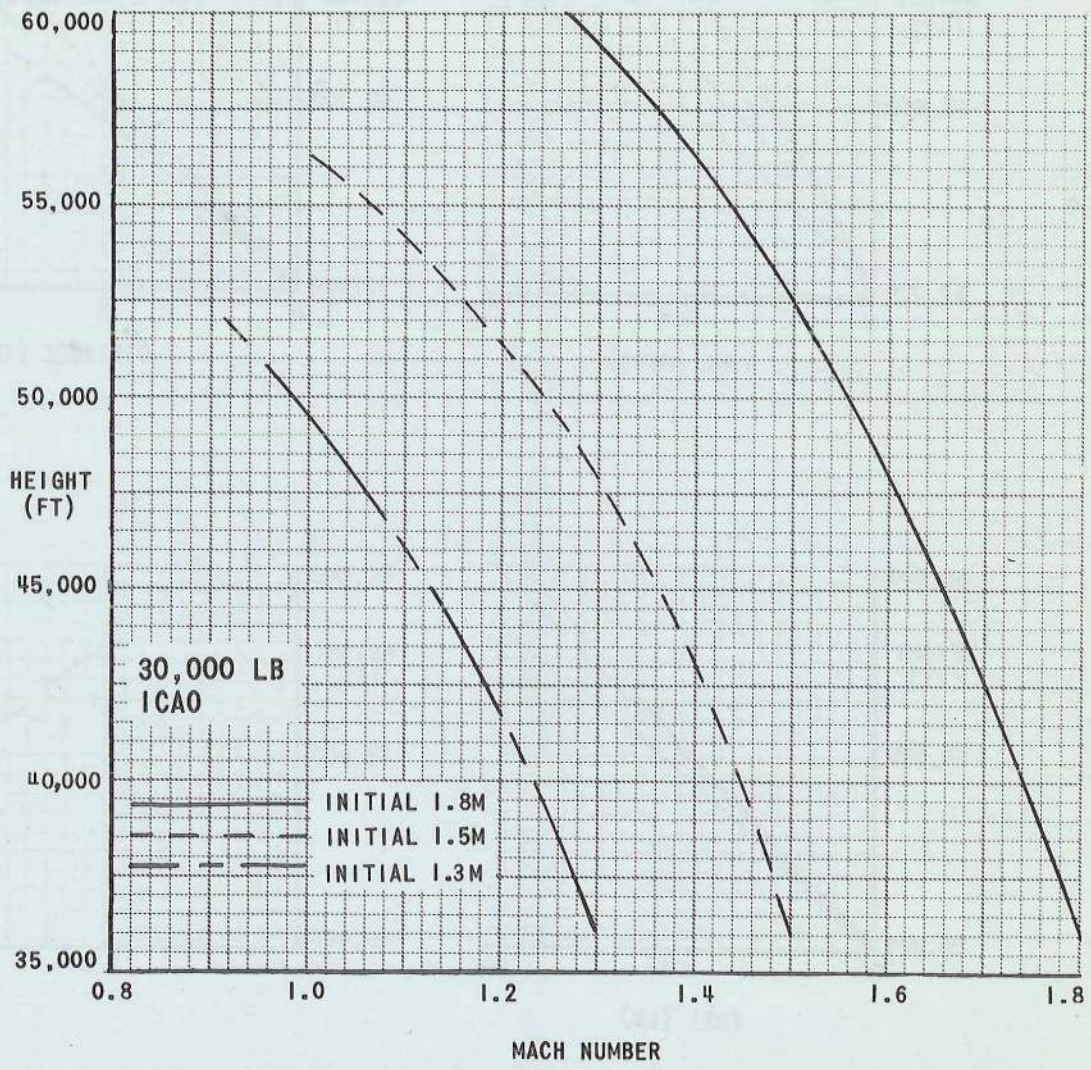
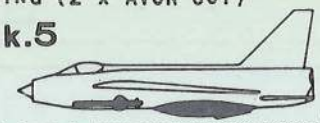
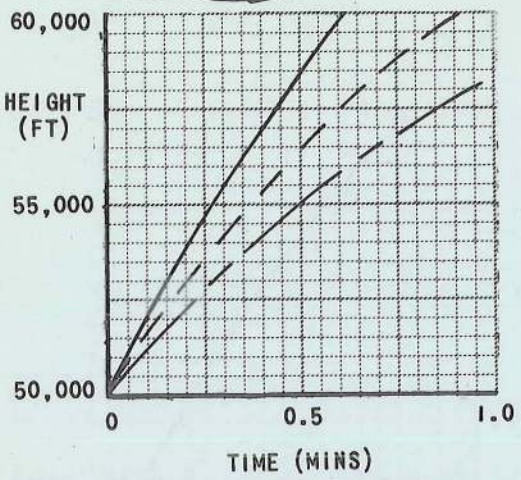
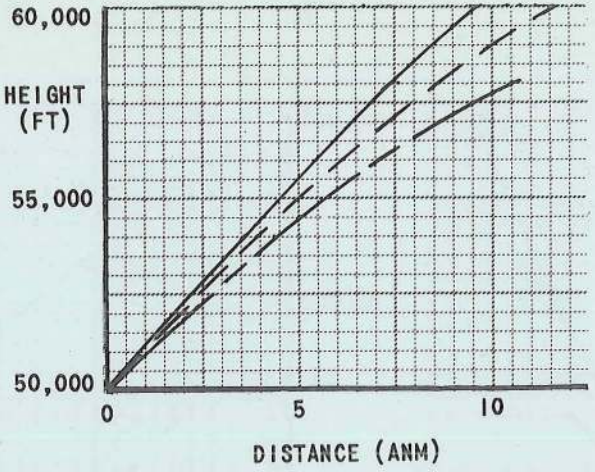


FIG. 3.17 CLIMB AT CONSTANT A/C ATTITUDE $\theta = 15°$ FUEL AND MACH NO.

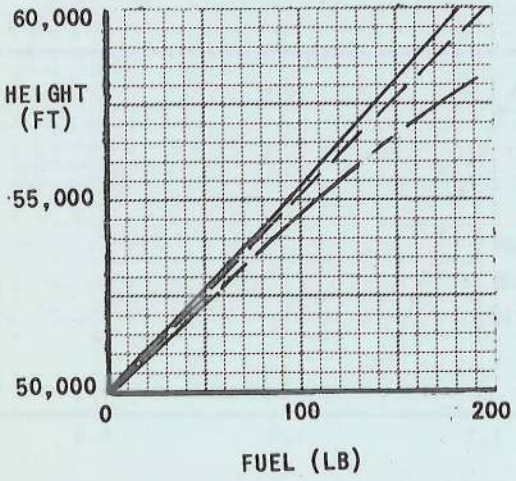






30,000 LB
ICAO

INITIAL 1.8M
INITIAL 1.5M
INITIAL 1.3M



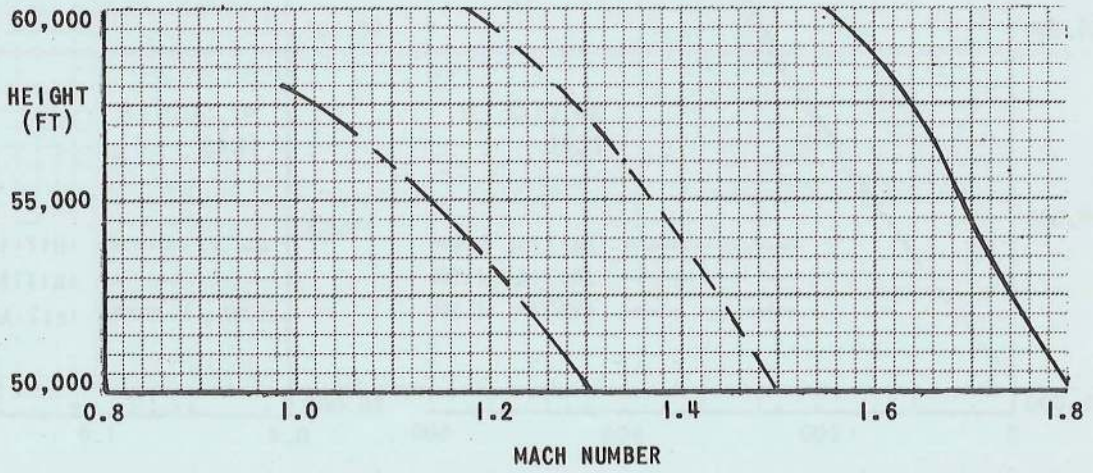
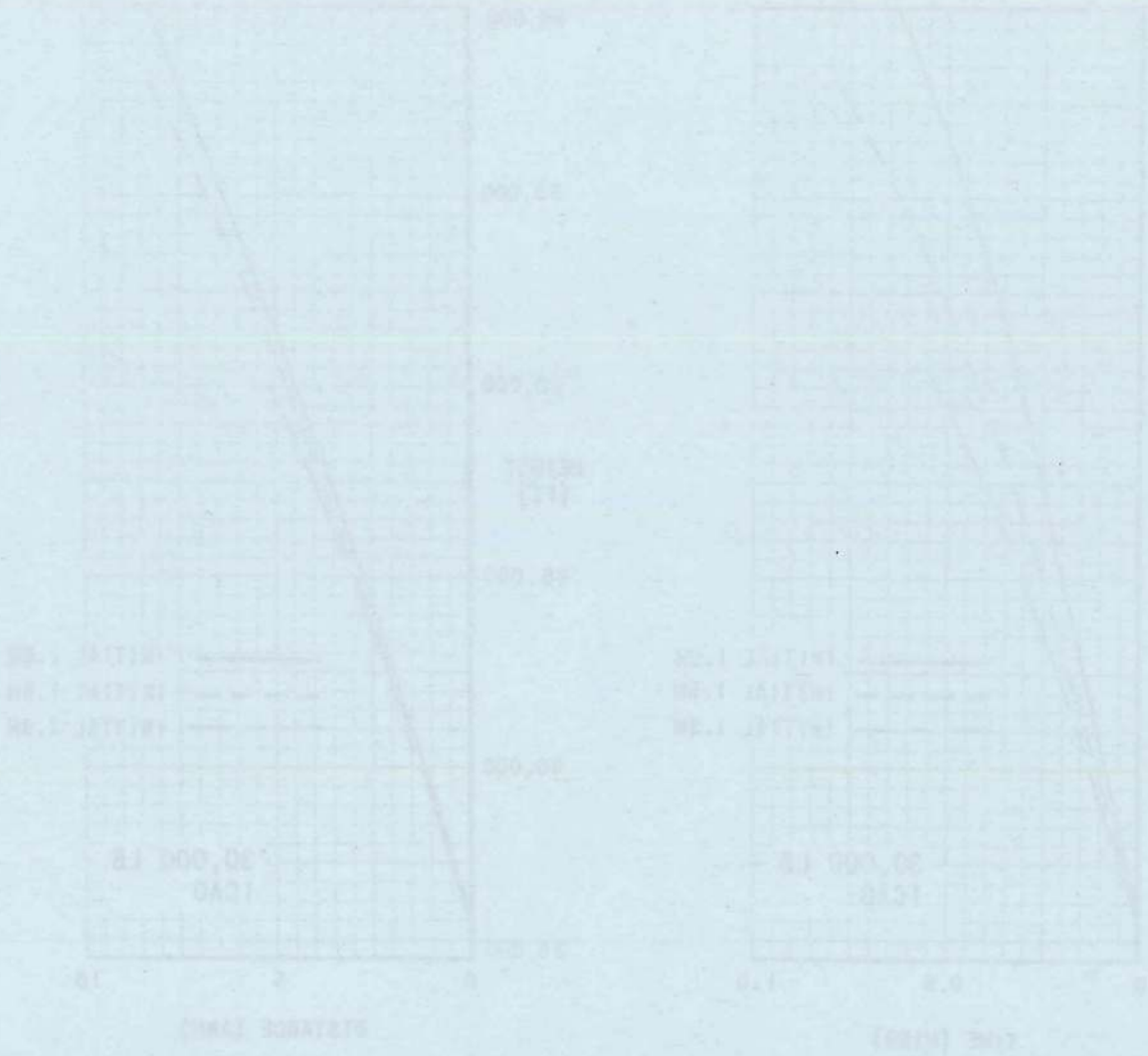
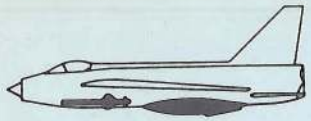
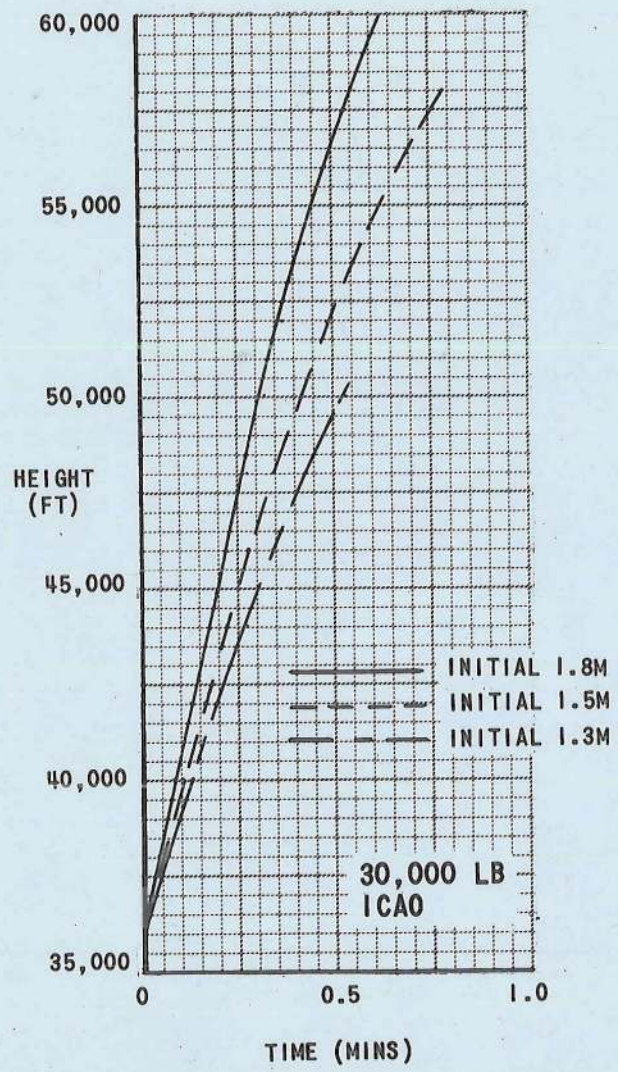


FIG. 3.18 CLIMB AT CONSTANT A/C ATTITUDE θ=15°
TIME, DISTANCE, FUEL AND MACH NO.



T Mk.5





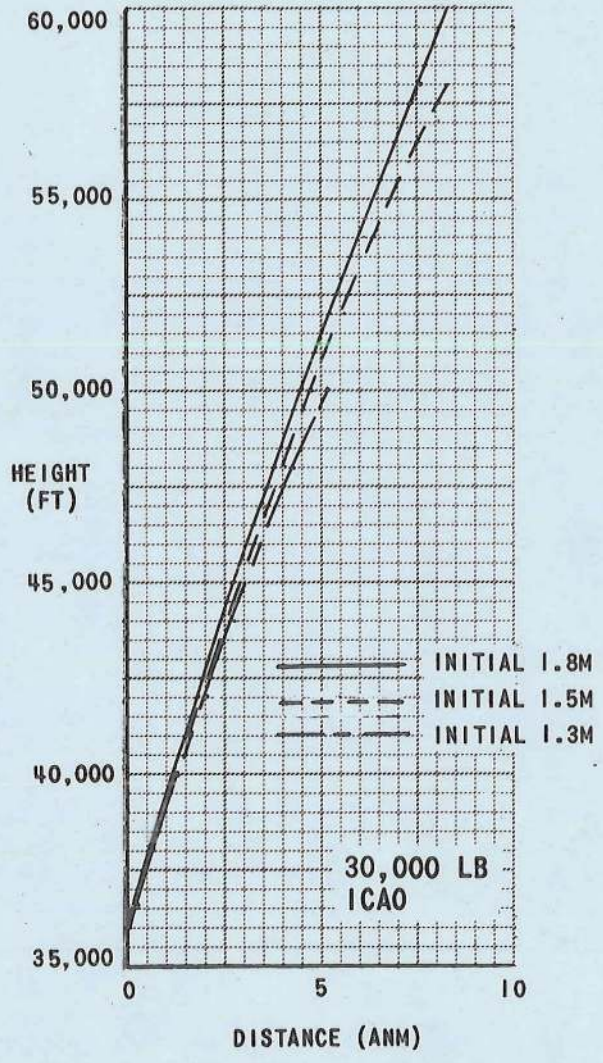
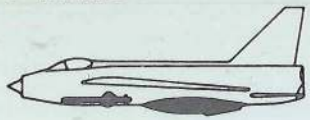
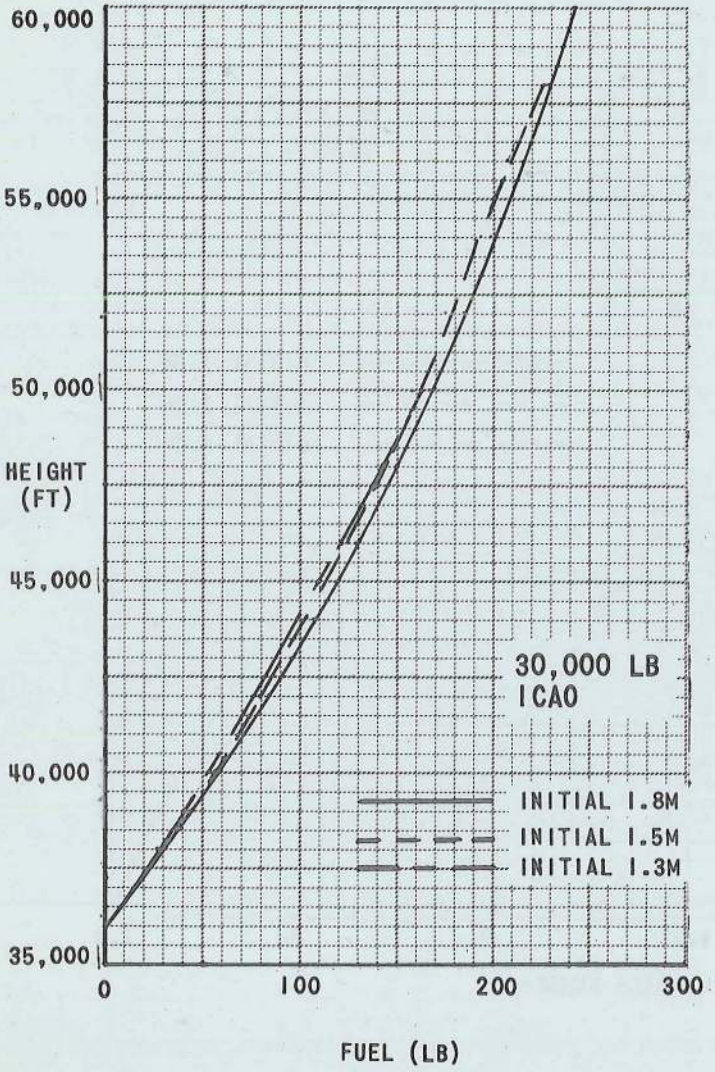


FIG. 3.19 CLIMB AT CONSTANT A/C ATTITUDE θ=30°
TIME AND DISTANCE





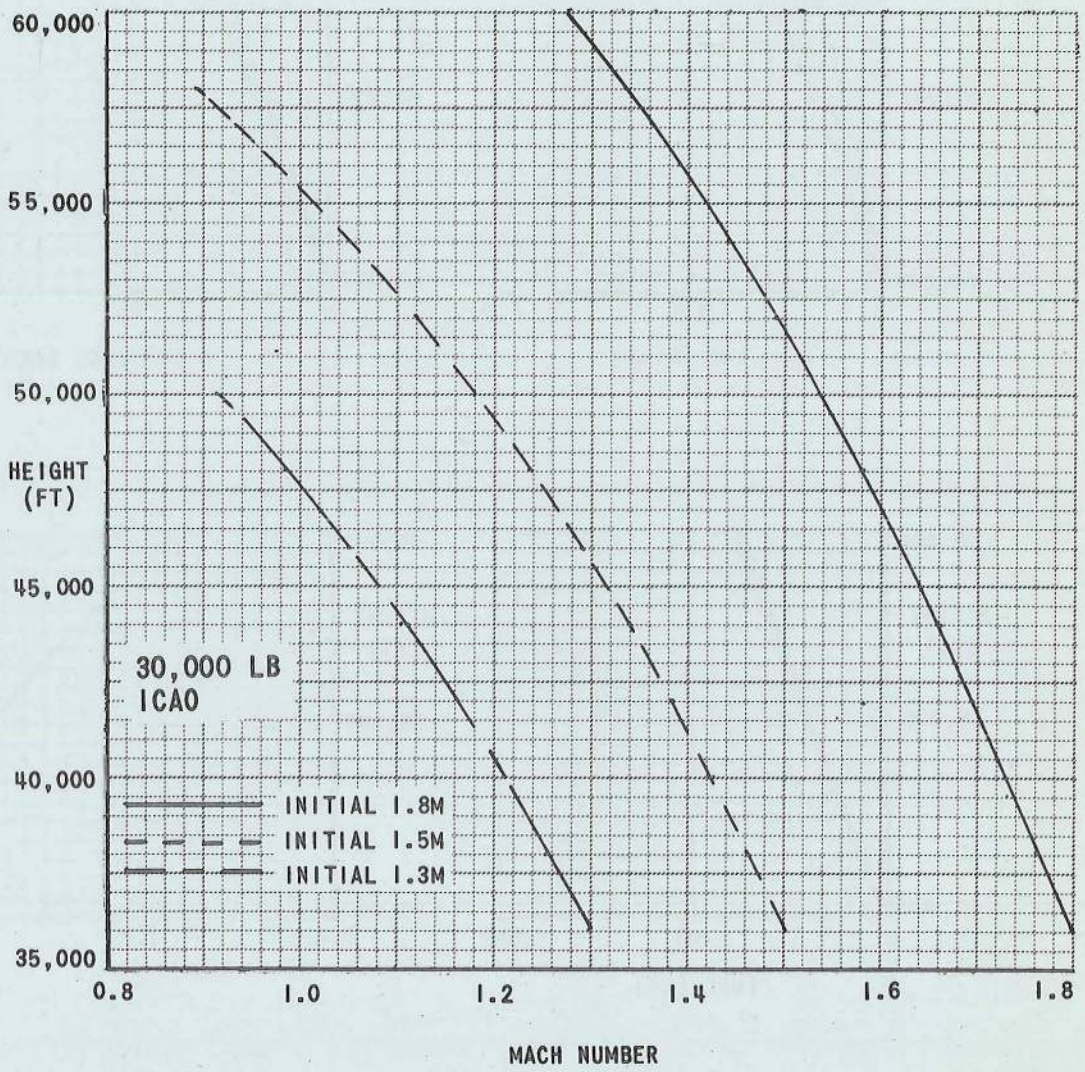
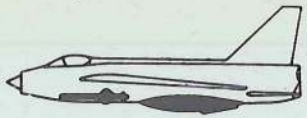
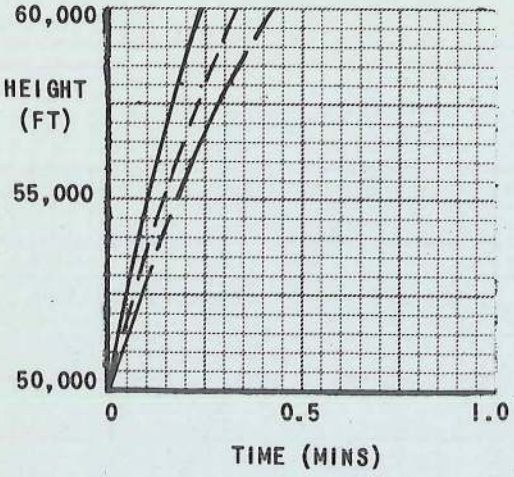
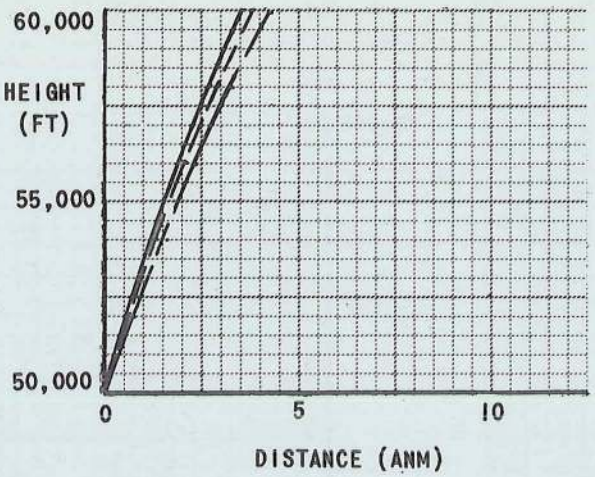


FIG. 3.20 CLIMB AT CONSTANT A/C ATTITUDE θ=30°
FUEL AND MACH NO.

T Mk.5

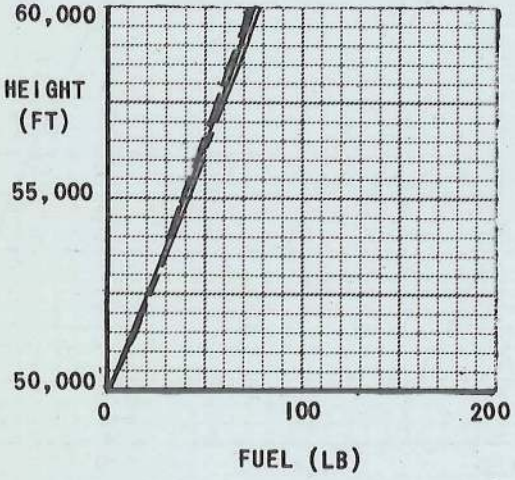






30,000 LB
ICAO

INITIAL 1.8M
INITIAL 1.5M
INITIAL 1.3M



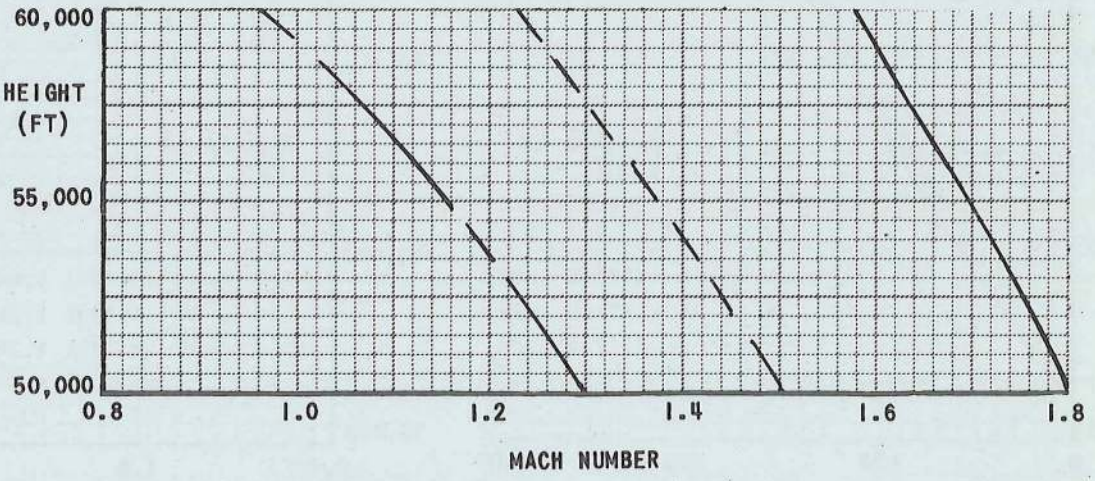


FIG. 3.21 CLIMB AT CONSTANT A/C ATTITUDE θ=30°
TIME, DISTANCE, FUEL AND MACH NO.