PERFORMANCE

The A-11A configuration is capable of 2,000 n.mi. radius mission cruising at Mach 3.2 at altitudes from 85,000 feet to 95,000 feet. The mission is summarized on Figure 1 and a distance-weight profile is shown on Figure 2. Airplane performance is summarized on Figure 3.

The mission comprises a full power take-off, climb and cruise. Fuel allowance for take-off and acceleration to climb speed is one minute at full power.

The climb performance is shown on Figure 4. The sea level rate of climb is 22,650 feet per minute and decreases with altitude to about 2,500 feet per minute at 74,000 feet. This part of the climb is made at a constant EAS of 400 Knots and an increasing true speed. Consequently a large part of the excess thrust is required for acceleration. Above 74,000 feet the climb is made at a constant Mach 3.2 and all of the excess thrust is available for climb. At 74,000 feet the rate of climb increases to 19,000 feet per minute and thereafter decreases rapidly to zero at 85,000 feet, the start of cruise. The climb uses 9,200 pounds of fuel, covers 250 n.mi., and requires 12.82 minutes.

The climbing cruise is made at maximum power at Mach 3.2. The cruise time is 2.08 hours including a 180 degree turn at the target point 2,000 n.mi. from take-off at an altitude of 91,000 feet. The end of cruise is at 95,000 feet over the base at Mach 3.2. An actual mission would include an idle

**PERFORMANCE** (cont.)

power descent starting 150 to 200 n.mi. from the base and would use less fuel than continuing the cruise to the base at altitude. A reserve allowance is included for a single engine 30-minute loiter at subsonic speeds at 35,000 feet altitude.

The take-off and the landing ground roll are 2,600 and 2,800 feet respectively. Speeds required for take-off and landing are based on an angle of attack of 11 degrees, which is the clearance angle with the main gear struts compressed. This provides an adequate ground clearance margin over the 15.5 degrees provided with the gear struts extended. Single engine safety during take-off is excellent since the total airplane drag is less than 20,000 pounds including dead engine and trim drag and the operating engine provides about 27,000 pounds of thrust. Single engine performance during landing is, of course, better due to the reduced weight.

Figure 1

## A-11A MISSION SUMMARY

(Two G.E. J93-5 Engines)

| | Weight Lbs. | Fuel Lbs. | Dist. N.Miles | Alt. Ft. |
|---|---|---|---|---|
| T.O. | 79,400 | 1,600 | 0 | S.L. |
| Climb | 77,800 | 9,200 | 250 | S.L. |
| Cruise Out | 68,600 | 18,500 | 1,750 | 85,000 |
| Target | 50,100 | - | - | 91,000 |
| Cruise Back | 50,100 | 15,100 | 2,000 | 95,000 |
| Reserve (30 min.) | 35,000 | 1,600 | - | 35,000 |
| ZFW | 33,400 | - | - | - |

Radius 2,000 n.mi. (180° turn at target)

46,000 Lbs. Total
(30,000 lbs. HEF used in afterburner,
16,000 lbs. JP150 used in primary)

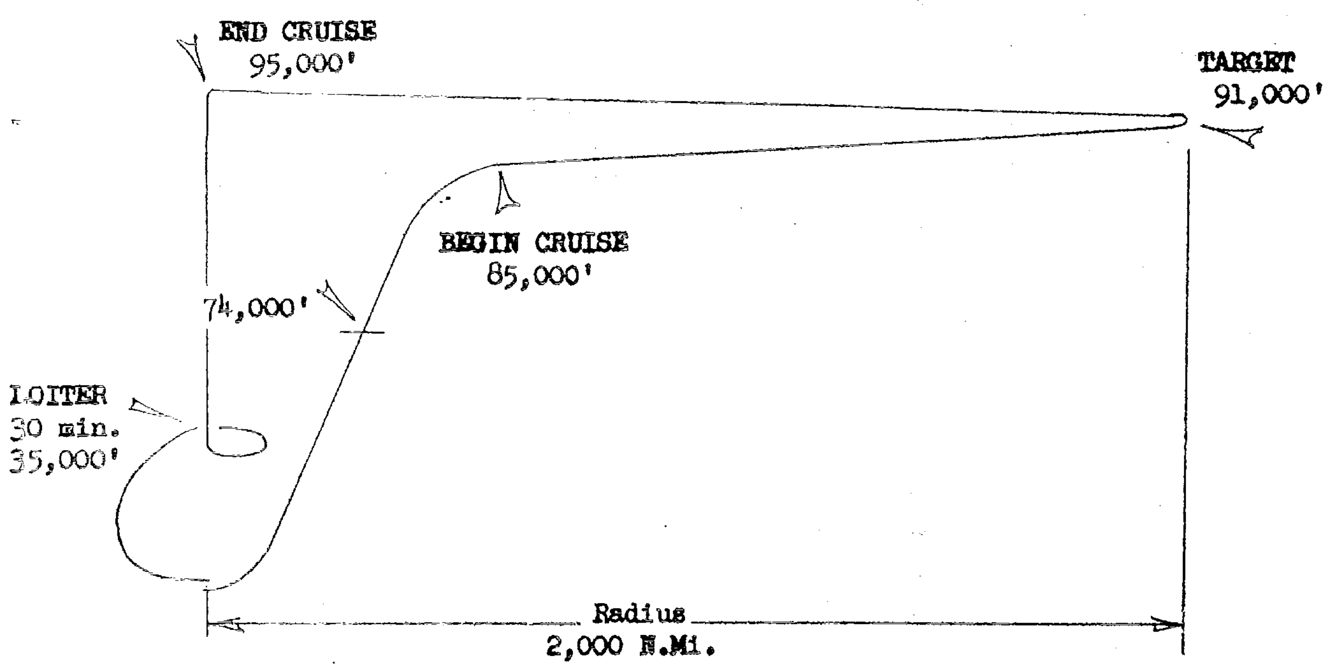
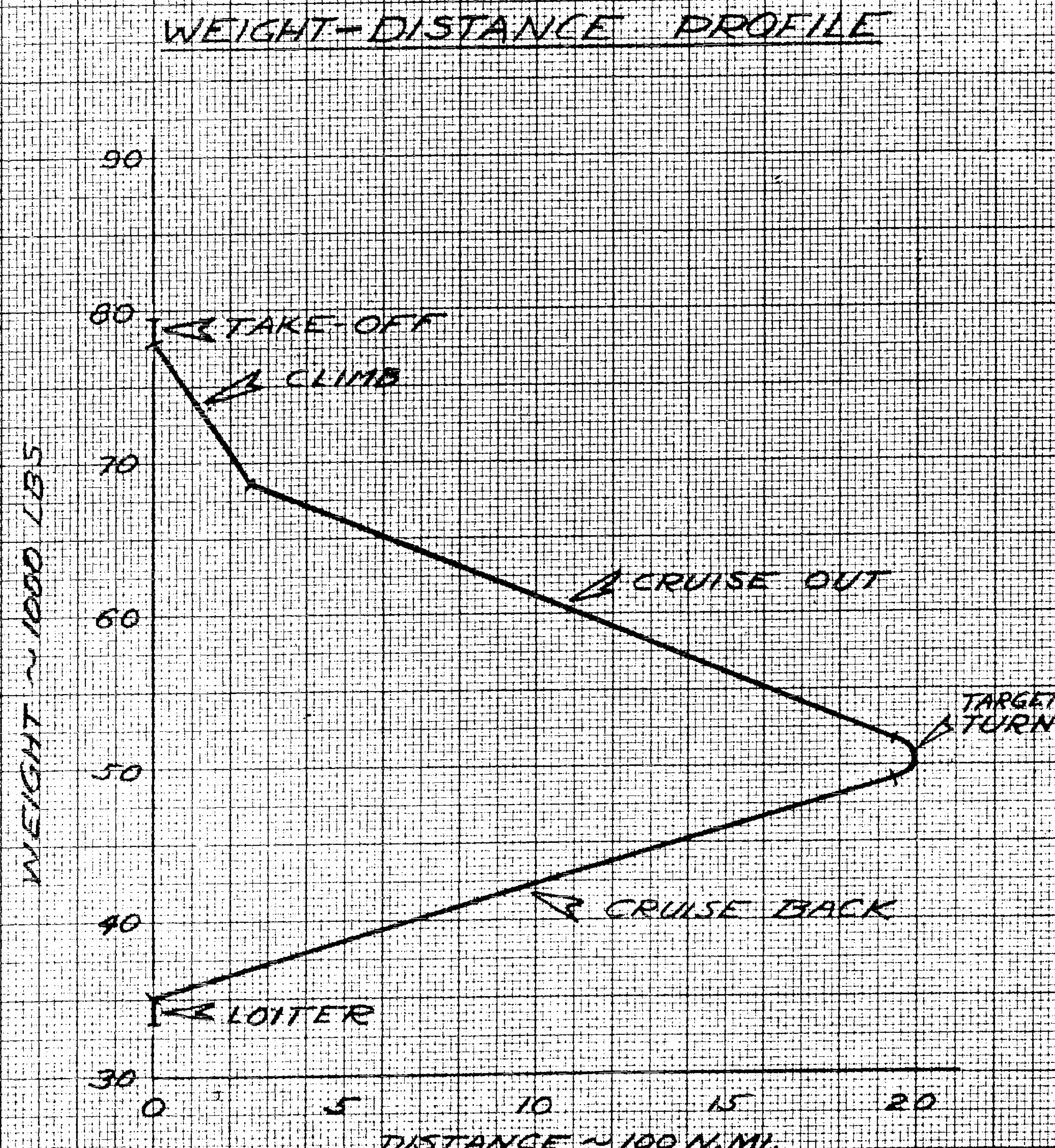


FIGURE 2

A-11A



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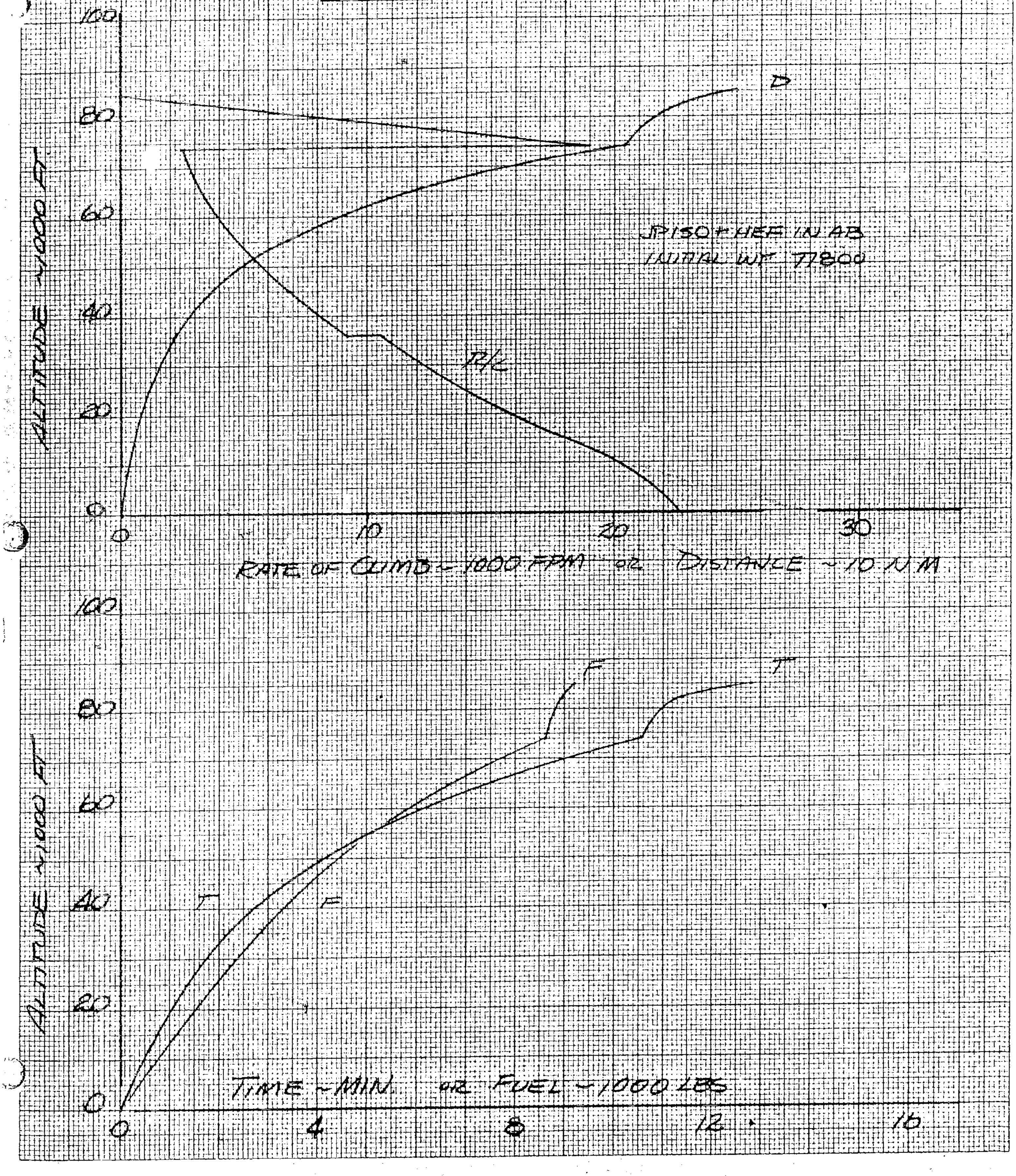
## A-11A PERFORMANCE SUMMARY

| | |
|---|---|
| Radius | 2,000 n.mi. |
| Take-off | |
| Weight (lbs.) | 79,400 |
| Speed (Kts) | 191 |
| Take-off Ground Roll (Feet) | 2,600 |
| Rate of Climb at S.L. at 400 Kts.(Ft./Min.) | 22,050 |
| Cruise | |
| Mach No. | 3.2 |
| Speed (Kts) | 1,865 |
| Altitude (Feet) | 85,000 to 95,000 |
| Target | |
| Altitude (Feet) | 91,000 |
| Weight (Lbs.) | 50,100 |
| Landing | |
| Weight (Lbs.) | 35,000 |
| Speed (Kts) | 127 |
| Distance (Feet) | 2,800 |

A-11-A

Figure 4

## CLIMB SUMMARY



## STRUCTURAL DESCRIPTION

This section covers the significant weight and structural changes between the A-11 configuration and the A-11A. Section IV of the main report gives a detailed coverage of the weight and structure of the A-11. The A-11A has smaller wing and tail, and J93 engines replace the J58 engines; these are the essential differences in the two configurations.

A weight of 4,990 lb. each is used for the J93 engine, this includes HEF provisions and self contained oil and starter systems. The weight summary is given on the following page and the center of gravity envelope is shown on Figure 1.

The wing structure has been investigated for the external loads given in Figure 2. The internal loads are not substantially different from those in the A-11 wing, the same type of wing structure will be used. The A-11 wing skin gauge is unchanged, this produces a slightly higher aileron reversal speeds for the A-11A. Figure 4 gives design speeds and aileron reversal speeds. All other loads and speeds are contained in Section IV of the main report.

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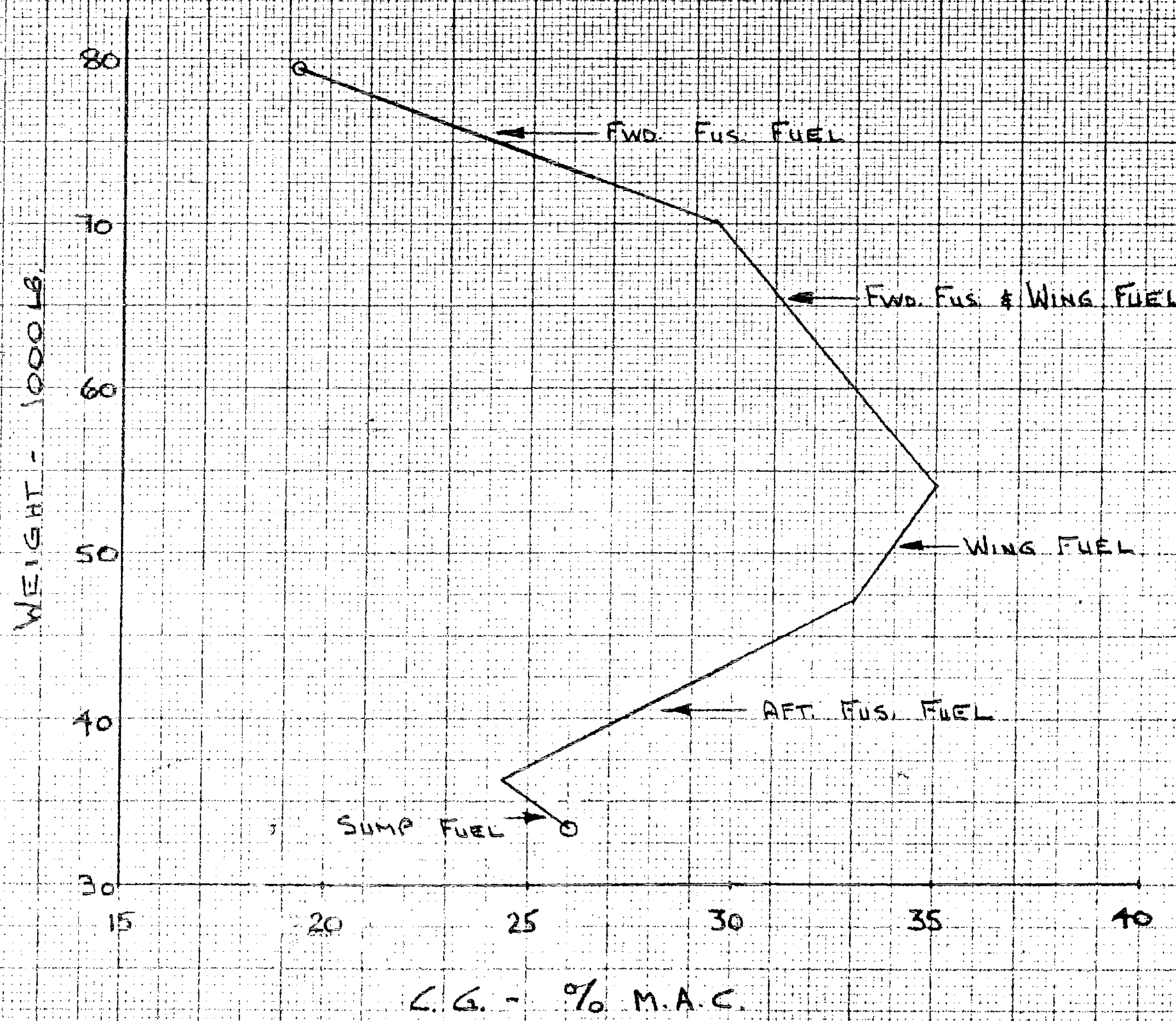
## WEIGHT SUMMARY

| | |
|---|---|
| WING | 8,160 |
| FIN | 1,320 |
| FUSELAGE | 4,550 |
| LANDING GEAR | 1,900 |
| SURFACE CONTROLS | 1,070 |
| NACELLES | 1,900 |
| PROPULSION GROUP | 11,160 |
| INSTRUMENTS | 110 |
| HYDRAULICS | 550 |
| ELECTRICS | 300 |
| ELECTRONICS | 425 |
| FURNISHINGS | 150 |
| AIR CONDITIONING | 750 |
| TAIL PARACHUTE | 70 |
| WEIGHT EMPTY | 32,415 |
| OXYGEN | 40 |
| OIL | 60 |
| UNUSABLE FUEL | 100 |
| PILOT | 285 |
| PAYLOAD | 500 |
| ZERO FUEL WEIGHT | 33,400 |
| FUSELAGE FUEL | 32,000 |
| WING FUEL | 14,000 |
| TAKE-OFF WEIGHT | 79,400 |

FORM 5707A-1

FIG. 1

# CENTER OF GRAVITY ENVELOPE



DATE ____________ LOCKHEED AIRCRAFT CORPORATION MODEL A-11A

CHECKED BY ____________ CALIFORNIA DIVISION REPORT NO. ____________

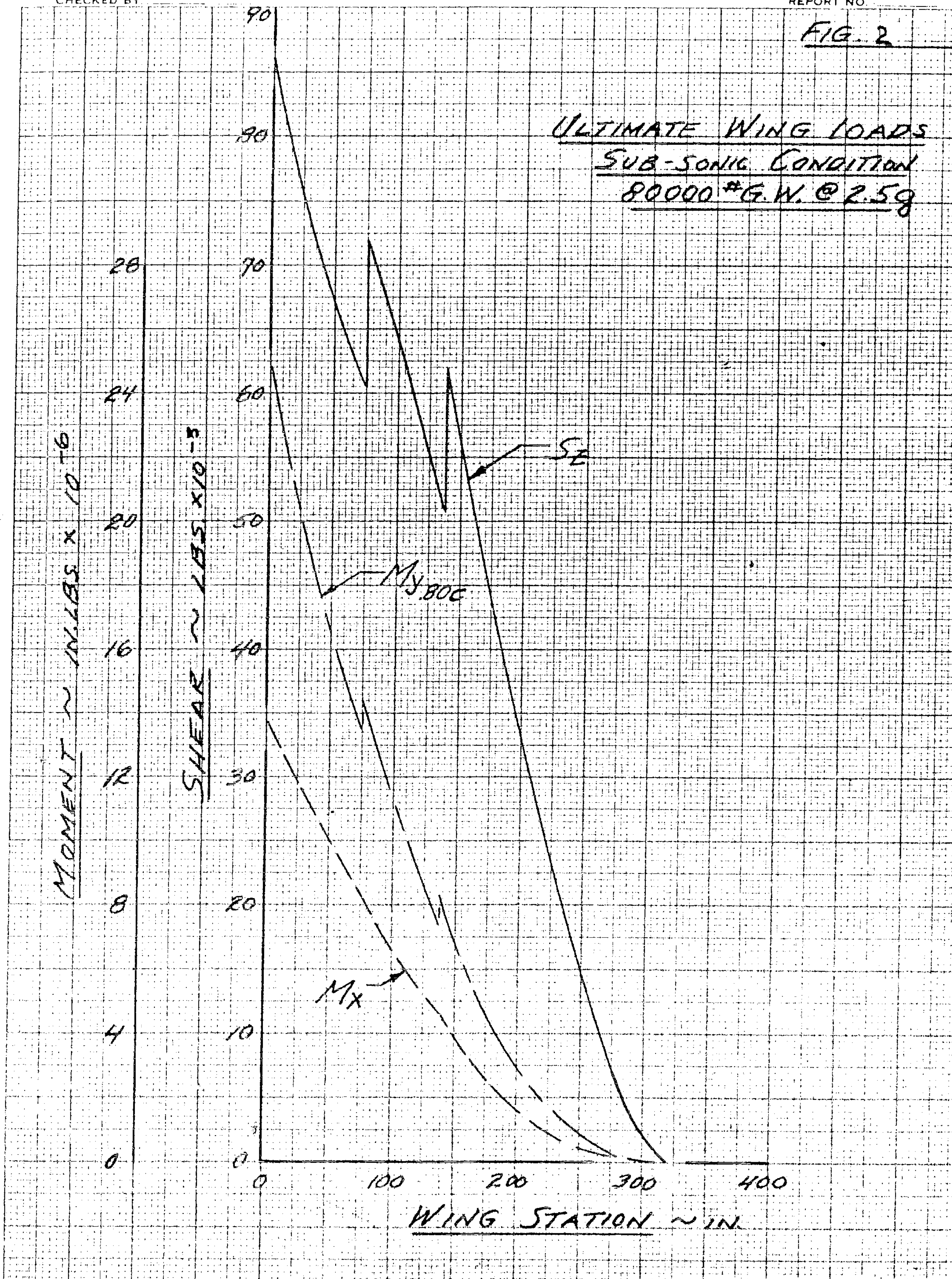



FIG. 2

ULTIMATE WING LOADS
SUB-SONIC CONDITION
80000# G.W. @ 2.5g

FORM 5276

FIG. 3

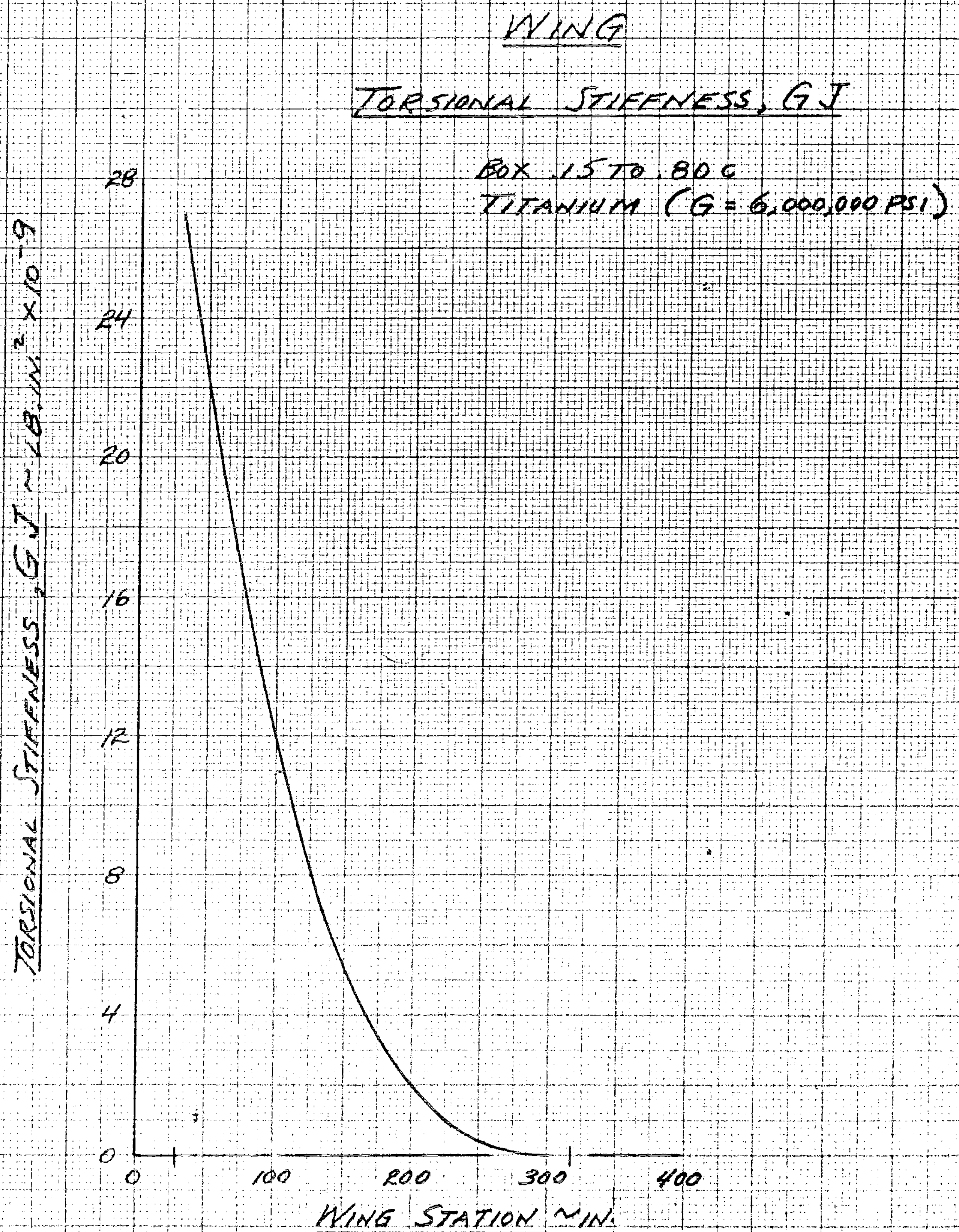
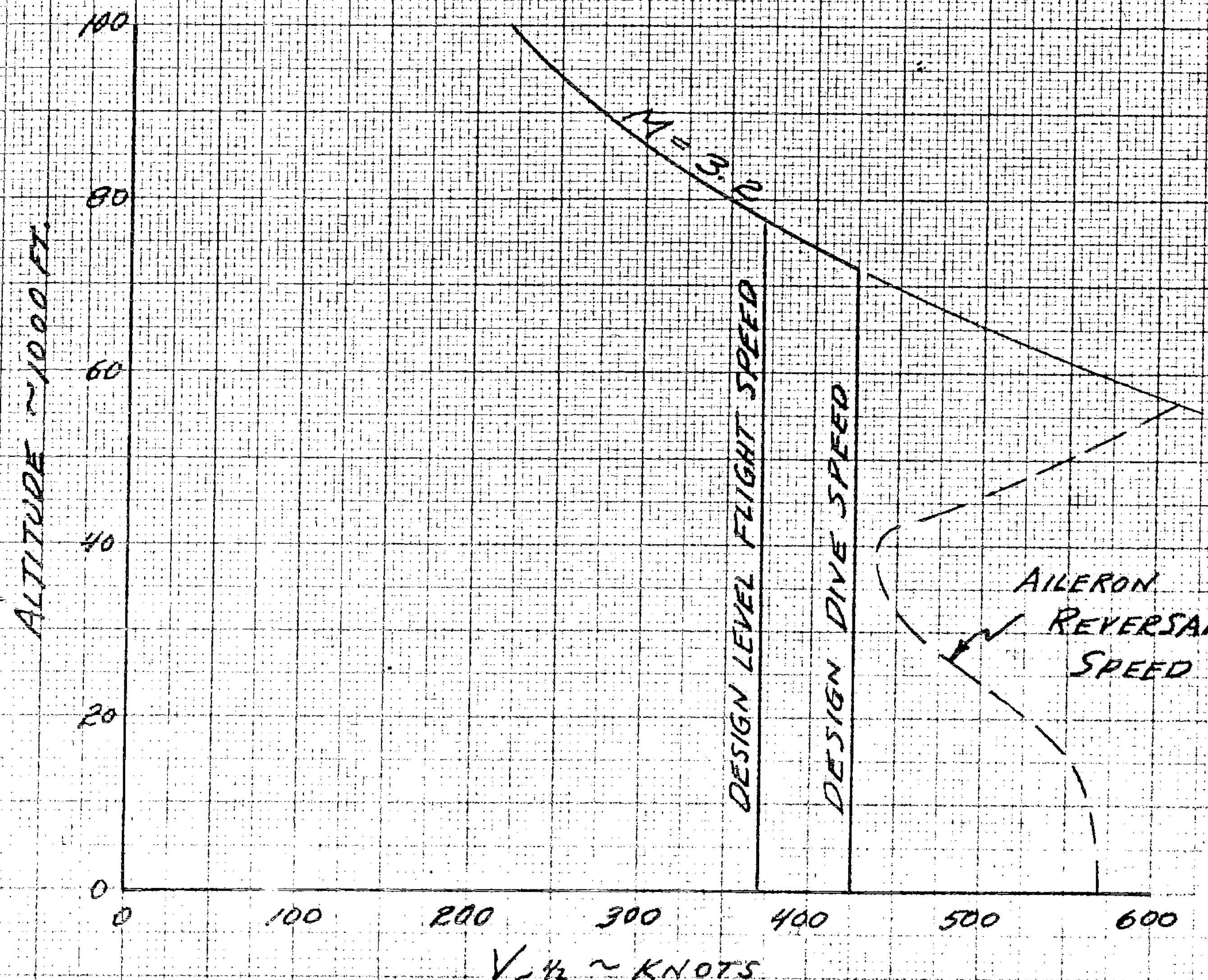

WING
TORSIONAL STIFFNESS, GJ
BOX .15 TO .80 C
TITANIUM (G = 6,000,000 PSI)
TORSIONAL STIFFNESS, GJ ~ LB.IN.² × 10⁻⁹
28
24
20
16
12
8
4
0
0
100
200
300
400
WING STATION ~ IN.

FIG. A

# SPEED - ALTITUDE CHART
## INCLUDING
## AILERON REVERSAL SPEED



A-11A

# THERMODYNAMICS

## A. POWER PLANT SYSTEM

### I. General Description

The General Electric J-93 turbojet engine was used as the powerplant for the A-11A airplane. This engine was considered as the alternate powerplant since it is the only other powerplant in the speed and altitude range of the A series airplanes which will be available should the J-58 engine program fail to materialize. The thrust to weight ratio of the J-93 engine is inferior to J-58 engine at the M = 3.2, 90,000 feet design condition.

Two versions of the J-93 were used in the analysis, the -5 engine which uses JP-150 fuel in the primary and HEF in the afterburner, and the -3 engine which is an all JP-150 engine.

The engine used in this section is an up-rated J-93 engine. The turbine inlet temperature has been boosted 100°F in the flight speed range from M = 0 to M = 2.0. At higher Mach numbers, the turbine inlet temperature is cut back to the original value.

The -5 and -3 engine performance are based on data presented in G.E. Bulletins R58AGT221 and R58AGT452 respectively, modified for the T.I.T. increase using G.E. curves 4012315-13 and 4012315-11 respectively.

A-11A

THERMODYNAMICS

A. POWER PLANT SYSTEM

I. General Description (cont.)

An engine weight of 4770 lbs. was used for the -3 engine and 4990 lbs. for the -5 engine.

The following are the manufacturer's quoted availability dates for the J-93 engine:

| | PFRT | MRT (150 hr.) |
|---|---|---|
| -3 engine (all JP-150) | Sept. 1960 | Sept. 1961 |
| -5 engine (JP-150 primary, HEF in A/B) | March 1963 | Nov. 1963 |

It should be noted that the -5 (HEF) engine availability is approximately two years later than the proposed airplane flight date.

II. Engine Performance

The installed J93-5 and J93-3 engine thrust and fuel flows at maximum power are presented in Figures 1 and 3 respectively. The performance is based on the inlet recoveries shown in Figure 4 of the Thermodynamics Section of Report SP-114. The data are for climb speed of 400 knots E.A.S. up to 74,000 feet and at M = 3.2 above 74,000 feet. Also shown are the uprated turbine inlet temperature data from S.L. to 55,000 feet (M = 2.0), and at normal turbine inlet temperature above 55,000 feet. Figures 2 and 4 show the variation of SFC with afterburner power for the -5 and -3 engines respectively.

A-11A

# THERMODYNAMICS

## A. POWER PLANT SYSTEM (cont.)

### III. Induction System Performance

The same type of induction system is proposed for the A-11A airplane as that used in the A-11 airplane (Report SP-114).

## B. AERODYNAMIC HEAT TRANSFER

The entire analysis presented in Report SP-114 for the A-11 airplane is applicable to the A-11A airplane.