# C 104/2

# SUPERSONIC ALL-WEATHER FIGHTER

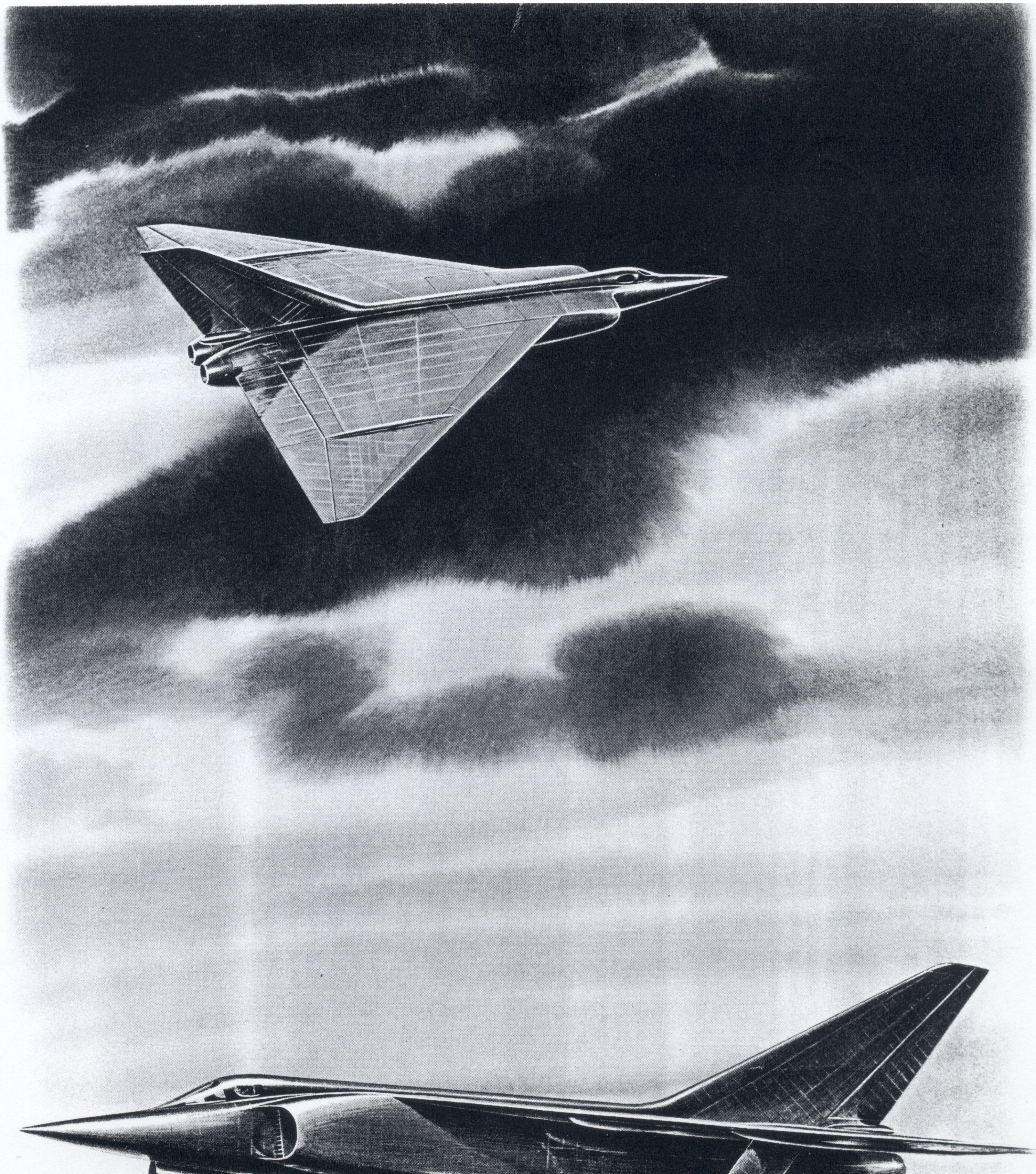
PROPOSAL NO.2

TWIN ENGINE AIRCRAFT

JUNE 1952

SECRET

A. V. ROE CANADA LIMITED
MALTON - ONTARIO



LIMIT DIVE SPEED - 720 KNOTS EAS
or MACH 2.0, whichever less.

## 1 SCOPE AND CLASSIFICATION

1.1 Details of the following airplane are covered in this brochure:-

| | |
|---|---|
| Service Model Designation ........ | Supersonic, all-weather fighter |
| Designer's Name and Model Designation ........................ | A.V.Roe Canada Ltd., - C-104/2 |
| Number and Places for Crew ...... | One (1) Pilot |
| Number and Kind of Engines........ | Two A.V. Roe Canada turbo-jet engines - TR9<br>or<br>Two Bristol Engine Co. turbo-jet engines - OL3 (fighter version)<br>or<br>Two Curtiss-Wright turbo-jet engines - J67 |

NOTE: Each type of engine will be fitted with an afterburner.

1.1.1 The mission of this airplane is to intercept and destroy any long-range bombers of the highest performance which are likely to be available to an enemy during the next five to ten years. Guided missiles and air-to-air rockets are used as the main offensive armament, the target tracking, aiming and fire control being automatically computed by airborne electronic equipment working in conjunction with ground signals.

1.1.2 The adaptability of this airplane to perform other missions, in addition to the above basic mission, is discussed in Appendix IV of this brochure and summarized in Appendix V.

## 2 APPLICABLE SPECIFICATIONS AND OTHER PUBLICATIONS

2.1 Specifications and publications used in the preparation of this brochure are as follows:-

(a) Handbook of Instructions for Aircraft designers, AMC 80-1 Edition, including revisions up to and including April, 1951.

(b) Air Force (USAF) Model Specification MIL-I-6252 dated 18 October, 1950.

## 3 REQUIREMENTS

3.1 Characteristics:

3.1.1 Refer to Figure 1 on the following page for information on the configuration of the airplane.

3.1.2 Performance:

3.1.2.1 Tabulated Performance:

TABLE 1

PERFORMANCE UNDER I.C.A.N. STANDARD ATMOSPHERIC CONDITIONS

| | |
|---|---|
| True Air Speed in Level Flight at Sea Level at Combat Weight (44,000 lb.): | |
| Maximum Thrust, Afterburners Lit ........ | 1,100 knots |
| Maximum Thrust........ | 669 knots |
| Maximum Continuous Thrust, Afterburners Lit ........ | 1,012 knots |
| Maximum Continuous Thrust ........ | 654 knots |
| True Air Speed in Level Flight at 50,000 ft. Altitude at Combat Weight (44,000 lb.): | |
| Maximum Thrust, Afterburners Lit ........ | 1,140 knots |
| Maximum Continuous Thrust, Afterburners Lit ........ | 1,006 knots |
| Operational Ceiling (rate of climb = 500 f.p.m.) at Combat Weight (44,000 lb.): | |
| Maximum Thrust, Afterburners Lit ........ | 55,000 ft. |
| Climb Thrust, Afterburners Lit ........ | 53,800 ft. |
| Maximum Continuous Thrust, Afterburners Lit ........ | 51,600 ft. |
| Maximum Rate of Climb at Sea Level at Maximum Take-off Gross Weight (52,000 lb.): | |
| Maximum Thrust, Afterburner Lit ........ | 42,000 f.p.m. |
| Climb Thrust, Afterburners Lit ........ | 38,300 f.p.m. |
| Climb Thrust ........ | 13,300 f.p.m. |
| Time to 50,000 ft. Altitude from a Standing Start at Maximum Take-off Gross Weight (52,000 lb.): | |
| Maximum Thrust, Afterburners Lit ........ | 5.2 min. |
| Climb Thrust, Afterburners Lit ........ | 6.8 min. |
| Take-off Distance over 50 ft. Obstacle with Maximum Thrust, Afterburners Lit, at Sea Level at Maximum Take-off Gross Weight (52,000 lb.) ........ | 2,940 ft. |
| Landing Distance over 50 ft. Obstacle at Sea Level at Combat Weight (44,000 lb.) ........ | 5,920 ft. |
| True Stalling Speed in Landing Configuration at Sea Level at Combat Weight (44,000 lb.) ........ | 104 knots |
| Combat Radius of Action with Combat at 50,000 ft. Altitude: | |
| High Speed Mission (Table 3) ........ | 242 naut.mi. |
| Maximum Range Mission (Table 4) ........ | 390 naut.mi. |

3.1.2.1.1 Engine Performance:

TABLE 2 - STATIC PERFORMANCE OF DEVELOPED TR9 ENGINE WITH AFTERBURNER UNDER I.C.A.N. STANDARD SEA LEVEL CONDITIONS

| Rating | Time Limit min. | Engine r.p.m. | Thrust lb. | Sp. Fuel Cons. lb/hr/lb. | J.P.T. °C |
|---|---|---|---|---|---|
| Maximum Take-off and Combat - Afterburner Lit | 15.0 (combined limit) | 5,500 | 21,450 | 1.848 | 669+869 |
| Maximum Take-off and Combat - Afterburner Unlit | 15.0 (combined limit) | 5,500 | 14,220 | .941 | 669 |
| Climb | 30.0 | 5,400 | 13,290 | .927 | 631 |
| Maximum Continuous | no limit | 5,250 | 11,780 | .901 | 580 |

3.1.2.1.2 Combat Radius - High Speed Mission:

TABLE 3 - COMBAT RADIUS OF ACTION - HIGH SPEED MISSION

| | Distance naut. mi. | Time min. | Fuel Consumed lb. | Aircraft Weight lb. |
|---|---|---|---|---|
| A. Start | - | - | - | 52,000 |
| B. Taxi and Warm-up | - | 4.0 | 760 | 51,240 |
| C. Take-off: Maximum Thrust, Afterburners Lit | - | .3 | 412 | 50,828 |
| D. Acceleration to Best Climbing Speed: Maximum Thrust, Afterburners Lit | 4 | .6 | 880 | 49,948 |
| E. Climb to 36,090 ft.: Climb Thrust, Afterburners Lit | 12 | 1.4 | 1,360 | 48,588 |
| F. Acceleration to Mach No. = 1.5: Maximum Thrust, Afterburners Lit | 15 | 1.3 | 890 | 47,698 |
| G. Climb to 50,000 ft.: Maximum Thrust, Afterburners Lit | 22 | 1.5 | 950 | 46,748 |
| H. Cruise-out at 50,000 ft. at Mach No.=1.5 | 189 | 13.2 | 4,780 | 41,968 |
| I. Combat at 50,000 ft. at Mach No. =1.5 | - | 5.0 | 1,740 | 38,978* |
| J. Descent to 40,000 ft. | 17 | 2.2 | 90 | 38,888 |
| K. Cruise-back at 40,000 ft., Economical Cruising Speed | 149 | 16.4 | 1,520 | 37,368 |
| L. Descent to 30,000 ft. | 24 | 3.1 | 200 | 37,168 |
| M. Stack at 30,000 ft. Maximum Endurance Speed | - | 15.0 | 1,100 | 36,068 |
| N. Descent to Sea Level | 52 | 6.3 | 710 | 35,358 |
| O. Approach, Maximum Endurance Speed | - | 5.0 | 608 | 34,750 |
| TOTAL: | 484 | 75.3 | 16,000 | |

Combat Radius of Action = 242 naut. mi.

*1,250 lb. of ammunition fired

3.1.2.1.3 Combat Radius - Maximum Range Mission:

TABLE 4 - COMBAT RADIUS OF ACTION - MAXIMUM RANGE MISSION

| | Distance naut. mi. | Time min. | Fuel Consumed lb. | Aircraft Weight lb. |
|---|---|---|---|---|
| A. Start | - | - | - | 52,000 |
| B. Taxi and Warm-up | - | 4.0 | 760 | 51,240 |
| C. Take-off: Maximum Thrust | - | .7 | 318 | 50,922 |
| D. Acceleration to Best Climbing Speed: Maximum Thrust | 6 | .9 | 446 | 50,476 |
| E. Climb to 36,090 ft.: Climb Thrust | 39 | 4.4 | 1,325 | 49,151 |
| F. Cruise-out at 36,090 ft.: Economical Cruising Speed | 312 | 34.4 | 3,915 | 45,236 |
| G. Acceleration to Mach No. =1.5 Maximum Thrust, Afterburners Lit | 13 | 1.1 | 830 | 44,406 |
| H. Climb to 50,000 ft.: Maximum Thrust, Afterburners Lit | 20 | 1.4 | 825 | 43,581 |
| I. Combat at 50,000 ft. at Mach No. =1.5 | - | 5.0 | 1,790 | 40,541* |
| J. Descent to 40,000 ft. | 17 | 2.2 | 90 | 40,451 |
| K. Cruise-back at 40,000 ft.: Economical Cruising Speed | 297 | 32.7 | 3,083 | 37,368 |
| L. Descent to 30,000 ft. | 24 | 3.1 | 200 | 37,168 |
| M. Stack at 30,000 ft.: Maximum Endurance Speed | - | 15.0 | 1,100 | 36,068 |
| N. Descent to Sea Level | 52 | 6.3 | 710 | 35,358 |
| O. Approach, Maximum Endurance Speed | - | 5.0 | 608 | 34,750 |
| TOTAL: | 780 | 116.2 | 16,000 | |

Combat Radius of Action = 390 naut. mi. *1,250 lb. of ammunition fired

3.1.2.1.4 Combat Fuel Allowances: The following table sets forth the combat fuel allowance based on 5 minutes at a Mach number of 1.5, together with the equivalent range at a Mach number of 1.5 and at maximum range speed. Comparative allowances for climbing to 50,000 ft. and turning through 180 degrees are also given.

TABLE 5 - COMBAT FUEL ALLOWANCES

| Altitude ft. | Combat Fuel Allowance lb. | Range at Mach No. 1.5 naut. mi. | Max. Range naut. mi. | Fuel to Climb to 50,000 ft. at M=.95 lb. | Fuel for 180° Turn at M=1.5 lb. |
|---|---|---|---|---|---|
| 50,000 | 1,800 | 72 | - | - | 1,142 |
| 45,000 | 2,040 | 72 | - | 612 | 874 |
| 40,000 | 2,403 | 72 | 198 | 908 | 811 |
| 36,090 | 2,758 | 72 | 232 | 1,065 | 774 |
| 20,000 | 5,150 | 72 | 347 | 1,322 | 892 |

3.1.2.1.5 The performance specified herein is based on estimated specific fuel consumption of the two TR9 engines, each one fitted with an afterburner.

3.1.2.1.6 Drag Estimate: Performance estimations specified herein are based on the drag estimate detailed in sub-paragraph 3.3.

3.1.2.1.7 Combat Radius - Sea Level Mission:

TABLE 6

COMBAT RADIUS OF ACTION - SEA LEVEL MISSION

| | Distance naut. mi. | Time min. | Fuel Consumed lb. | Aircraft Weight lb. |
|---|---|---|---|---|
| A. Start | - | - | - | 52,000 |
| B. Taxi and Warm-up | - | 4.0 | 760 | 51,240 |
| C. Take-off: Maximum Thrust, Afterburners Lit | - | .3 | 412 | 50,828 |
| D. Acceleration to Mach No.=.95: Maximum Thrust, Afterburners Lit | 4 | .6 | 880 | 49,948 |
| E. Cruise-out at Mach No.=.95 | 98 | 9.4 | 3,050 | 46,898 |
| F. Acceleration to Mach No.=1.09: Maximum Thrust, Afterburners Lit | 2 | .2 | 326 | 46,572 |
| G. Combat at Mach No.=1.09 | - | 5.0 | 7,020 | 38,302* |
| H. Climb to 30,000 ft.: Climb Thrust | 21 | 2.3 | 780 | 37,522 |
| I. Cruise-back at 30,000 ft.: Economical Cruising Speed | 31 | 3.3 | 354 | 37,168 |
| J. Stack at 30,000 ft.: Maximum Endurance Speed | - | 15.0 | 1,100 | 36,068 |
| K. Descent to Sea Level | 52 | 6.3 | 710 | 35,358 |
| L. Approach: Maximum Endurance Speed | - | 5.0 | 608 | 34,750 |
| TOTAL: | 208 | 51.4 | 16,000 | |

Combat Radius of Action
=
104 naut. mi.

*1,250 lb. of ammunition fired

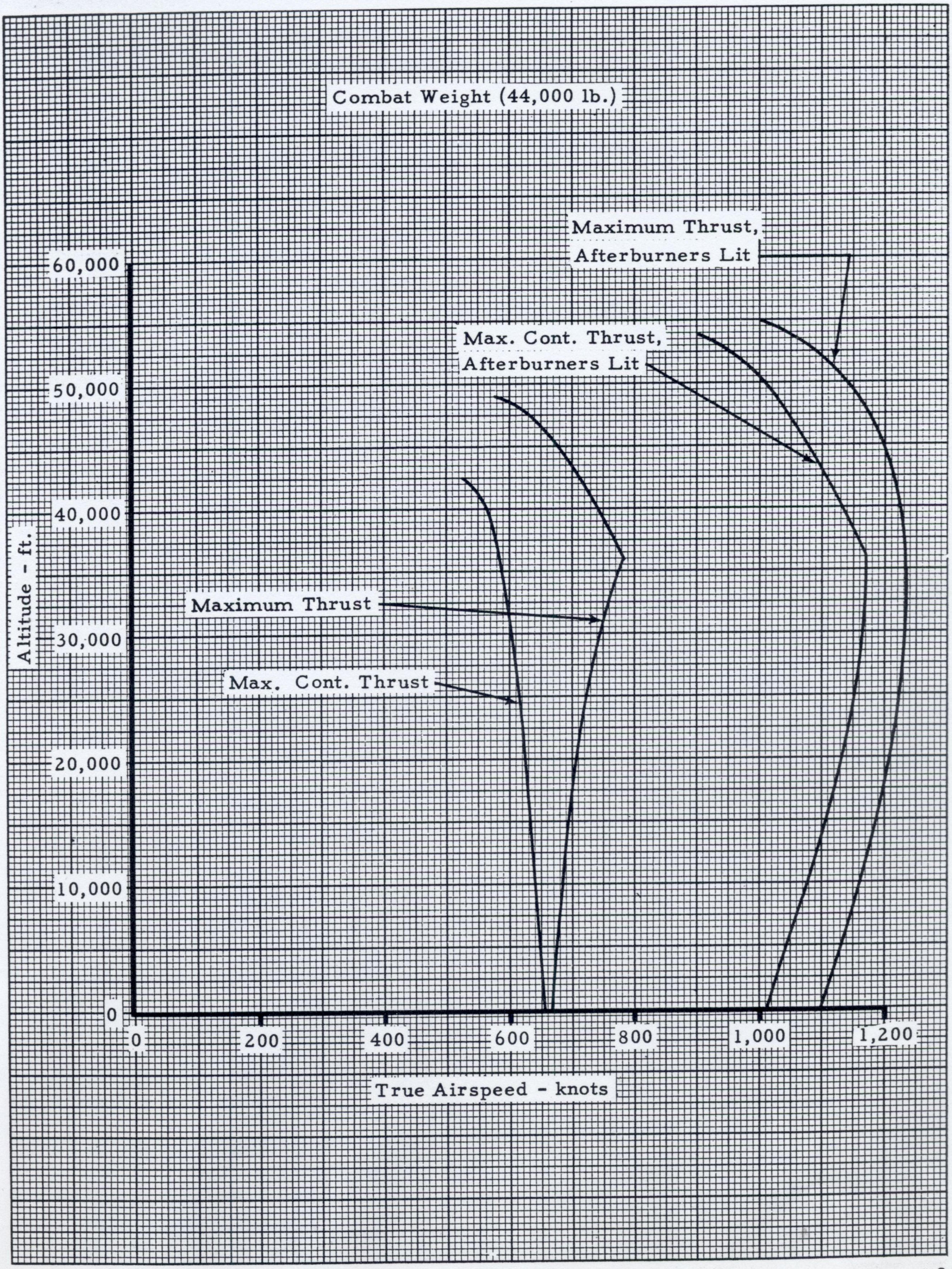





Fig. 2 Level Flight True Airspeed

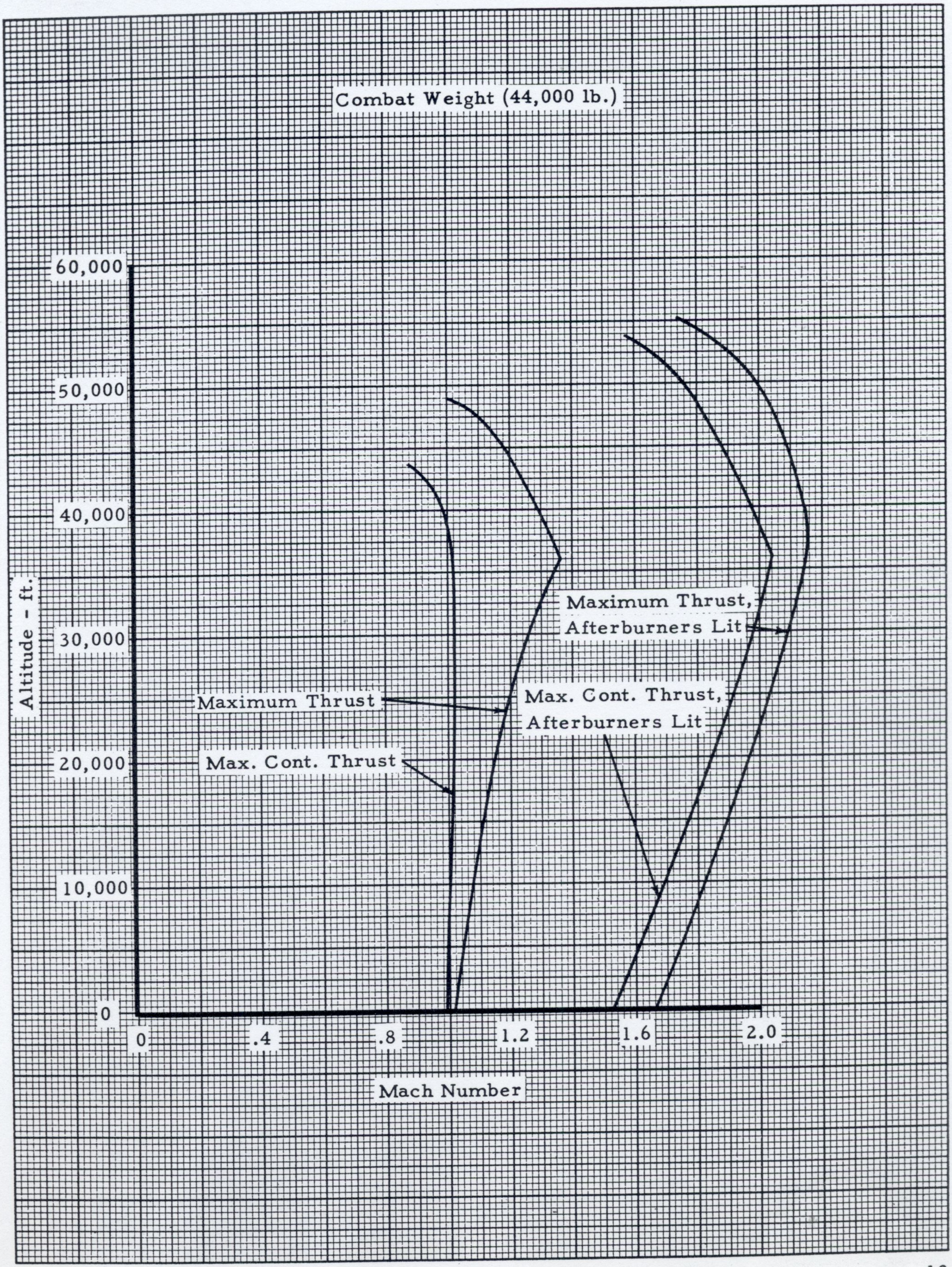





Fig. 3 Level Flight Mach Number

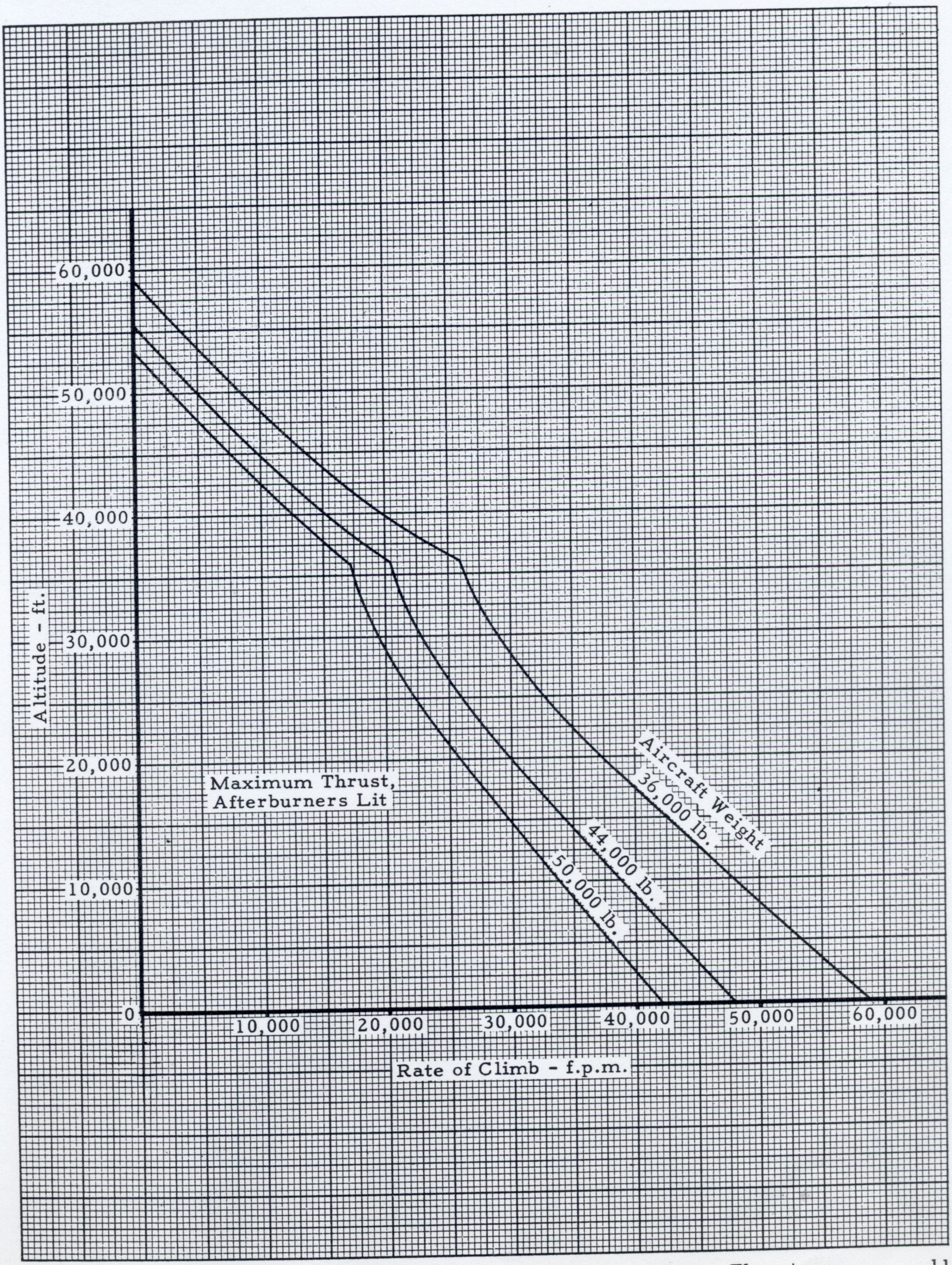





Fig. 4 Maximum Steady Rate of Climb - Maximum Thrust

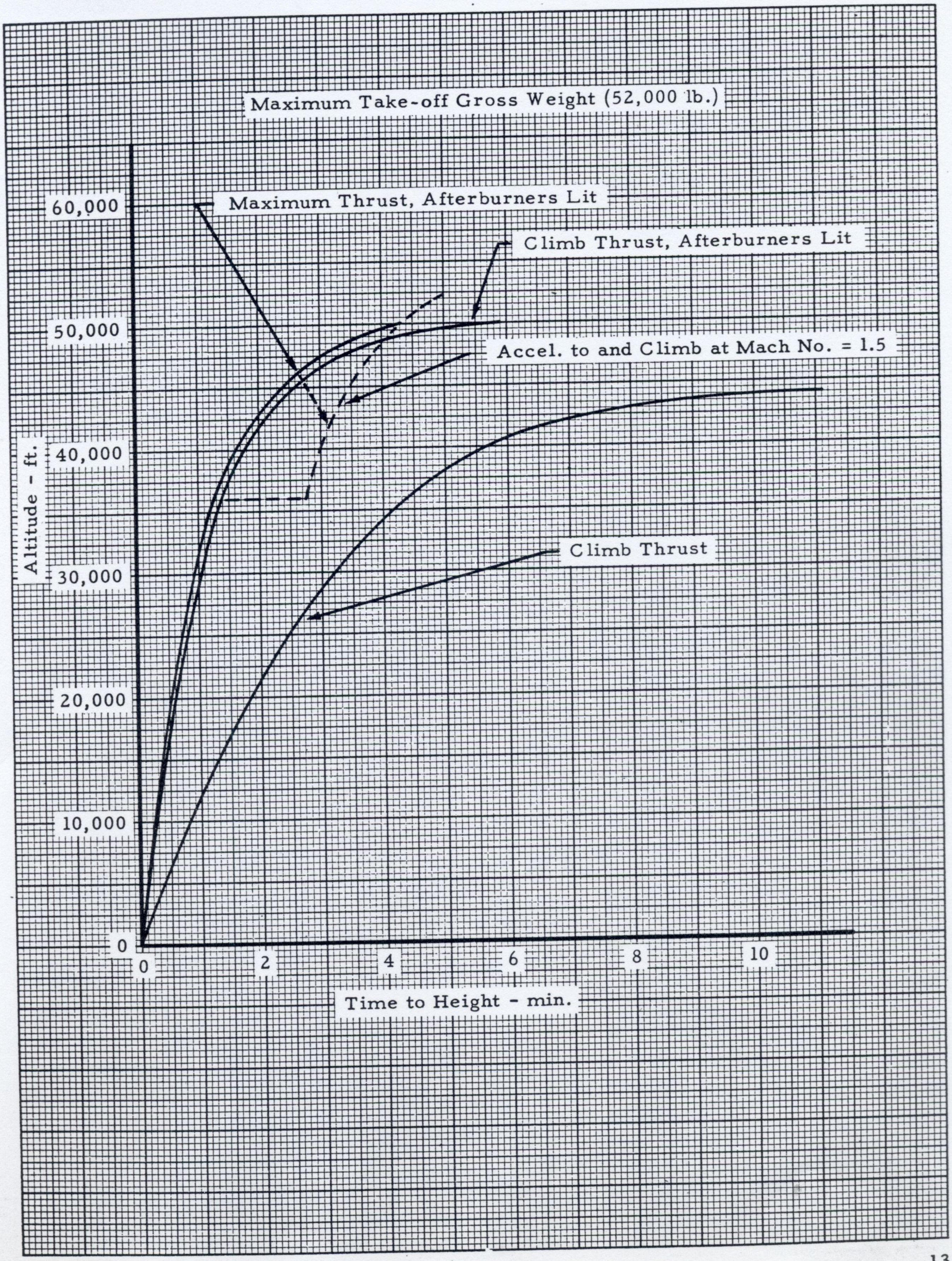





Fig. 6 Time to Height

3.1.3 Weights: Following is a list of the component weights of this airplane. Details of the c.g. balance calculations may be found by referring to Appendix VI at the back of this brochure.

TABLE 7 - STRUCTURE AND POWERPLANT

| Item | Weight (lb.) |
|---|---|
| WING GROUP: | |
| Wing | 9,200 |
| Ailerons | 215 |
| Elevators | 325 |
| TAIL GROUP: | |
| Fin and rudder | 1,000 |
| BODY GROUP: | |
| Front fuselage | 2,940 |
| Rear nacelle | 335 |
| Speed brakes | 163 |
| Engine doors | 567 |
| Underwing structure | 620 |
| LANDING GEAR: | |
| Main undercarriage - including jacks | 2,162 |
| Nose undercarriage - including jacks | 427 |
| Tail skid | 30 |
| ENGINE SECTION: | |
| Shrouds, firewall, drainplate | 430 |
| Engine mounting | 40 |
| POWER PLANT GROUP: | |
| Engines - dry weight (as per RCAF-Eng-62-1 issue 4, Appendix II) | 7,544 |
| Engine controls | 20 |
| FUEL SYSTEM: | |
| Tanks | 490 |
| Piping, pumps etc. | 440 |
| FIRE EXTINGUISHER SYSTEM | 65 |
| ENGINE DE-ICING | 185 |
| ACCESSORIES GEAR AND DRIVES | 15 |
| AFTERBURNERS - COMPLETE | 1,872 |
| TOTAL: | 29,085 |

## TABLE 8 - FIXED EQUIPMENT GROUP

| Item | Weight (lb.) |
|---|---|
| INSTRUMENTS | 53 |
| SURFACE CONTROLS: | 700 |
| Elevators, ailerons, rudder speed brakes - including jacks and artificial feel | |
| HYDRAULIC SYSTEM | 678 |
| ELECTRICAL SYSTEM | 790 |
| HUGHES ELECTRONIC EQUIPMENT: | |
| Nose radar | 210 |
| Cockpit equipment | 190 |
| Main equipment bay | 1,400 |
| ARMAMENT PROVISIONS | 200 |
| FURNISHINGS: | |
| Ejector seat | 132 |
| Emergency accommodations | 15 |
| Oxygen | 20 |
| AIR CONDITIONING AND PNEUMATIC SYSTEMS | 355 |
| BRAKE PARACHUTE | 75 |
| EXTERIOR FINISH | 70 |
| ANTI-ICING SYSTEM | 210 |
| TOTAL: | 5,158 |
| TOTAL BROUGH FWD.: | 29,085 |
| WEIGHT EMPTY: | 34,243 |

## TABLE 9 - UNIT WEIGHTS

| Component | Unit Weight |
|---|---|
| WING GROUP (Gross Area 1189.4 sq. ft.) lbs. per. sq. ft. | 8.18 |
| TAIL GROUP (Gross Area 155 sq. ft.) lbs. per sq. ft. | 6.45 |
| WEIGHT OF FUEL SYSTEM PER GAL. CAP. (1,958 Imperial gal. of fuel) | .475 |

TABLE 10 - USEFUL LOAD

| Item | Weight (lb.) |
|---|---|
| CREW - ONE (1) PILOT | 207 |
| FUEL: | |
| Usable | 16,000 |
| Total residual | 260 |
| OIL | 40 |
| ARMAMENT: | |
| Guided missiles (6) | 660 |
| Rockets (24) | 590 |
| TOTAL: | 17,757 |
| WEIGHT EMPTY: | 34,243 |
| GROSS WEIGHT: | 52,000 |

TABLE 11 - DESIGN INFORMATION

| | | | |
|---|---|---|---|
| Length - max. | 70 ft. 3 in. | Design gross weight | 52,000 lb. |
| Height - max. | 21 ft. 3 in. | Stressing weight and load factor: | |
| Span | 48 ft. 0 in. | At combat weight | 44,000 lb. |
| Thickness - root chord | 3% | Ultimate load factor | 11.00 g. |
| Thickness - tip chord | 3% | Limit load factor | 7.33 g. |
| Wing area - net | 822 sq. ft. | Factor of safety | 1.50 |
| Taper ratio (Root chord/tip chord) | 11.49:1 | Airplane weight immediately after take-off | 50,000 lb. |
| Length - root chord | 45 ft. 7 in. | Ultimate load factor | 9.67 g. |
| Length - tip chord | 4 ft. 0 in. | Limit load factor | 7.33 g. |
| Maximum fuselage depth | 6 ft. 4 in. | Factor of safety | 1.33 |
| Maximum fuselage width | 8 ft. 8 in. | | |

3.1.3.1 Alternate Loading: Refer to Appendix IV at the back of this brochure for alternate loading information.

3.1.3.2 Gross weight estimations are as follows:-

Design gross weight ........................ 52,000 lb.

3.1.4 Center of Gravity Locations:

Take-off gross weight, c.g. location, wheels up:

Aft l.e. of m.a.c. ........................ 27.65% m.a.c

Below l.e. of m.a.c. ........................ 1.02 ft.

| | |
|---|---|
| Design gross weight, c.g. location, wheels down: | |
| Aft l.e. of m.a.c. ... ... ... ... ... ... ... ... | 28.10% m.a.c. |
| Below l.e. of m.a.c. ... ... ... ... ... ... ... | 1.29 ft. |
| Extreme forward position, c.g. possible in flight regardless of loading at take-off - wheels up: | |
| Aft l.e. of m.a.c. ... ... ... ... ... ... ... ... | 27.65% m.a.c. |
| Below l.e. of m.a.c. ... ... ... ... ... ... ... | 1.02 ft. |
| Gross weight for this condition ... ... ... ... | 52,000 lb. |
| Extreme rearward position, c.g. possible in flight regardless of loading at take-off - wheels down: | |
| Aft l.e. of m.a.c. ... ... ... ... ... ... ... ... | 30.95% m.a.c. |
| Below l.e. of m.a.c. ... ... ... ... ... ... ... | 1.74 ft. |
| Gross weight for this condition ... ... ... ... | 34,750 lb. |

3.1.5 Areas:

| | |
|---|---|
| Wing area, total including ailerons and elevators | 1189.4 sq. ft. |
| Elevator area aft of hinge line (each) ... ... ... | 51.55 sq. ft. |
| Aileron area aft of hinge line (each) ... ... ... | 30.25 sq. ft. |
| Vertical tail area, total ... ... ... ... ... ... ... | 155 sq. ft. |
| Fin - to rudder hinge ... ... ... ... ... ... ... | 122 sq. ft. |
| Rudder, aft of hinge ... ... ... ... ... ... ... ... | 33 sq. ft. |
| Speed brakes: | |
| Upper (each) - projected ... ... ... ... ... | 7.75 sq. ft. |
| Lower (each) - projected ... ... ... ... ... | 12.25 sq. ft. |

NOTE: The control surfaces are power-operated and do not incorporate aerodynamic balance aids.

3.1.6 Dimensions and General Data:

| | |
|---|---|
| Wings: | |
| Span, maximum ... ... ... ... ... ... ... ... ... | 48 ft. 0 in. |
| Chord: | |
| At root ... ... ... ... ... ... ... ... ... ... ... | 45 ft. 7 in. |
| At construction tip (theoretical extended section at tip) ... ... ... ... ... ... ... ... | 4 ft. 0 in. |
| Mean aerodynamic ... ... ... ... ... ... ... | 30 ft. 7.2in. |
| Airfoil section designation and thickness (percent chord) ... ... ... ... ... ... ... ... | NACA (Modified) 0003-63 |
| At root ... ... ... ... ... ... ... ... ... ... ... ... | 3% |
| At construction tip (theoretical extended section at tip) ... ... ... ... ... ... | 3% |
| Average (frontal area divided by wing area) ... | 3% |

3.12 Propulsion:

3.12.1 General Description and Components: The airplane is propelled by two turbo-jet engines, each with an afterburner. The complete installation is mounted inside the rear of the fuselage as shown in Fig. 26.

3.12.2 Main Propulsion Unit: Any one of the following turbo-jet engines may be installed:-

(a) The AVRO Canada TR9

(b) The Curtiss Wright J67

(c) The Bristol Olympus OL3 (fighter version).

Afterburners will be fitted to whichever engines are used. All these engines will give approximately the same performance. As the engine sizes and weights are very similar, the installation details will not differ greatly. Maximum sea level static thrust of each engine will be 15,000 lb. in their fully developed state, although the rating of initial engines may only be from 13,000 - 14,000 lb. Of the engines proposed, the Olympus is already in an advanced stage of development, a slightly reduced version now giving 10,600 lb. thrust with a specific fuel consumption of 0.78 lb/lb/(thrust)/hour. A larger version of this engine (OL3 - bomber version) is scheduled to run in the middle of 1953. Accordingly, it is reasonable to expect that engines of this type and specification will be available by 1955. The Olympus - and its Curtiss Wright variant - have two compressors and turbines mounted on separate concentric shafts but working in series. This permits a very low fuel consumption, obtained at the expense of some mechanical complication. The AVRO TR9, on the other hand, is a conventional engine having only one shaft. This gives a slightly simpler and cheaper engine but with a higher fuel consumption.

3.12.2.1 The missions for which this airplane is primarily designed are accomplished using supersonic speeds. These are obtained with the afterburner lit for the greater part of the time. Under these conditions, a reduction in the fuel consumption of the main engine does not result in any appreciable change in the overall picture. The range, however, would be increased somewhat for subsonic missions if an Olympus type engine were used. All engines ~~are~~ will be suitable for use at supersonic speeds and are stressed for fighter load factors.

3.12.2.2 Afterburners: The afterburner will be designed to use a temperature of 1,800 deg. K. It will be fitted with an adjustable nozzle which is infinitely variable in cross section between the required limits. The control system will be so devised that the afterburner can be operated with a maximum of efficiency down to not more than 80% of the maximum permissible engine r.p.m. The nozzle operating mechanism will be constructed so that the external lines are sufficiently well faired, for all nozzle openings, in order to achieve a negligible base drag.

# APPENDIX IV D

## Operational Trainer Version

## Model Designation: C104/2/D

A trainer version of the basic airplane is shown in Fig. 36. As will be seen from the illustration, this is essentially the same airplane as the fighter version but with a longer cockpit section. Conversion from the basic airplane is rapidly accomplished by unbolting the cockpit section of the fuselage forward of the transport joint bulkhead to which the nose gear leg is attached and replacing it with the longer trainer cockpit section.

If it is desired to carry the same armament and electronic equipment in the trainer as in the operational fighter, the resulting increase in gross weight together with the longer fuselage will, of course, detract somewhat from the performance as quoted in this brochure for the basic fighter airplane. Ballast is not required in the tail of the airplane since the most forward center of gravity is still within the limits allowed from considerations of stability and control.

# APPENDIX IV F

## Photographic Reconnaissance Version

## Model Designation: C104/2/F

The exceptionally large armament bay of the basic airplane makes it possible to accomodate all equipment required for an unarmed photographic reconnaissance version of this airplane and furthermore to provide for an additional 1940 lb. of fuel. Refer to Fig. 38 which shows a proposed installation of the photographic equipment, together with the extra fuel tanks. The photographic equipment which has been assumed conforms to RCAF Operational Requirement No. ORI/1-31 which was issued in draft form for a CF-100 conversion on December 20, 1949. The following equipment has been shown installed:-

For day operation:-

(a) Left and right lateral oblique K/F24 cameras (7/8 in. lense).

(b) A pair of split vertical F52 cameras (20 in. lense).

(c) A vertical Sonne 57A stereo camera with 7 in. lense and ground speed synchronizer.

(d) Left and right forward facing oblique K/F24 cameras with 7/8 in. lenses. These will be mounted in wing tip fairings and are not shown in the illustration.

For night operation:-

(a) One vertical K19B camera with photo electric pick-up unit and amplifier.

(b) Ten multiple chamber flash cartridge dischargers containing sixty cartridges (SIS5343 and AP1661).

(c) Floodlight (29.75 in. dia. - Raytheon A-123G-X1).

(d) Power unit (Raytheon A-123F-X1).

(e) Two condensers (Raytheon A-123E-X1).

The gross weight of this airplane with the extra amount of fuel is 1800 lb. heavier than the basic fighter version. Balast is not required. The range of this P.R. version will be of the order of 550 nautical miles.

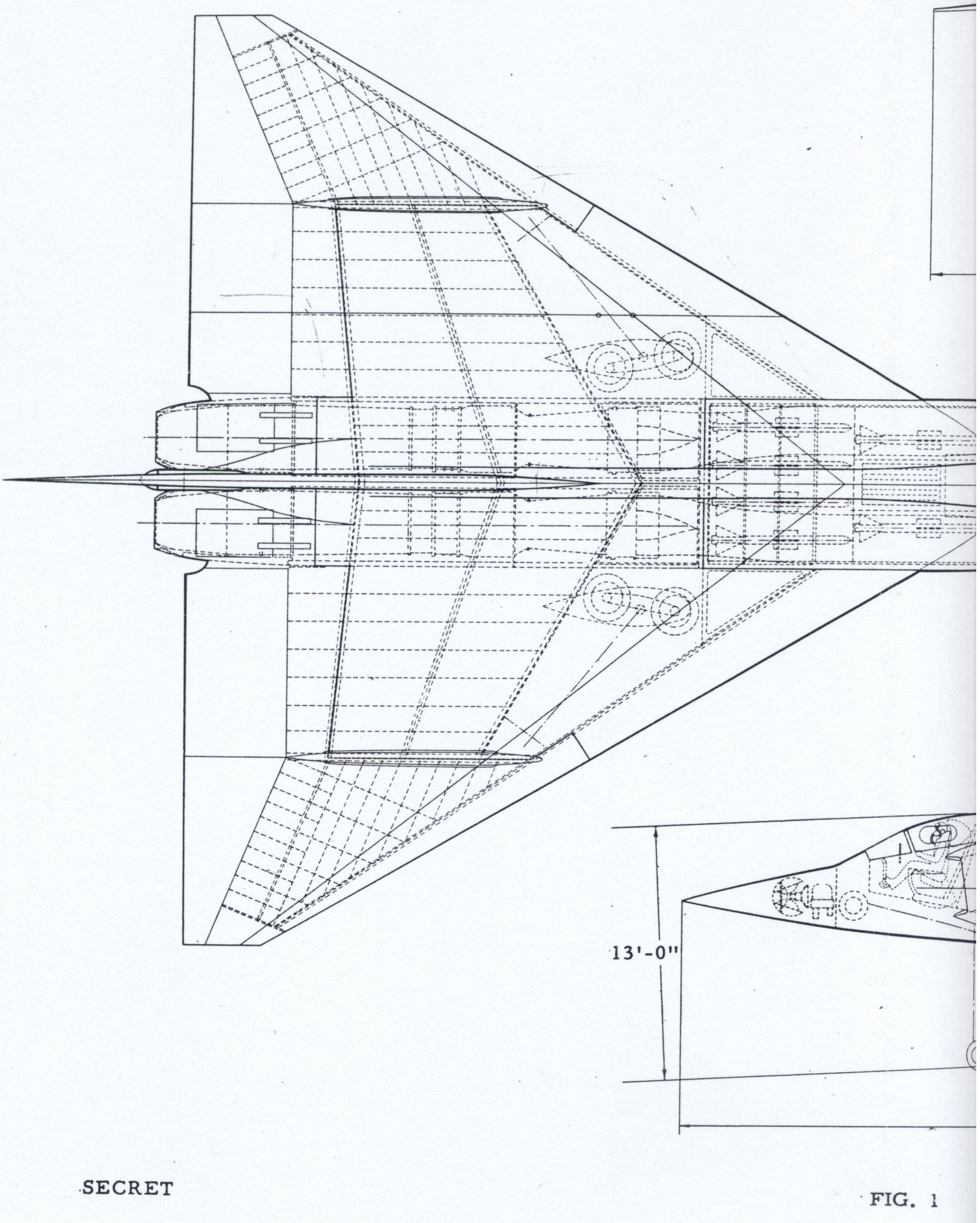





FIG. 1

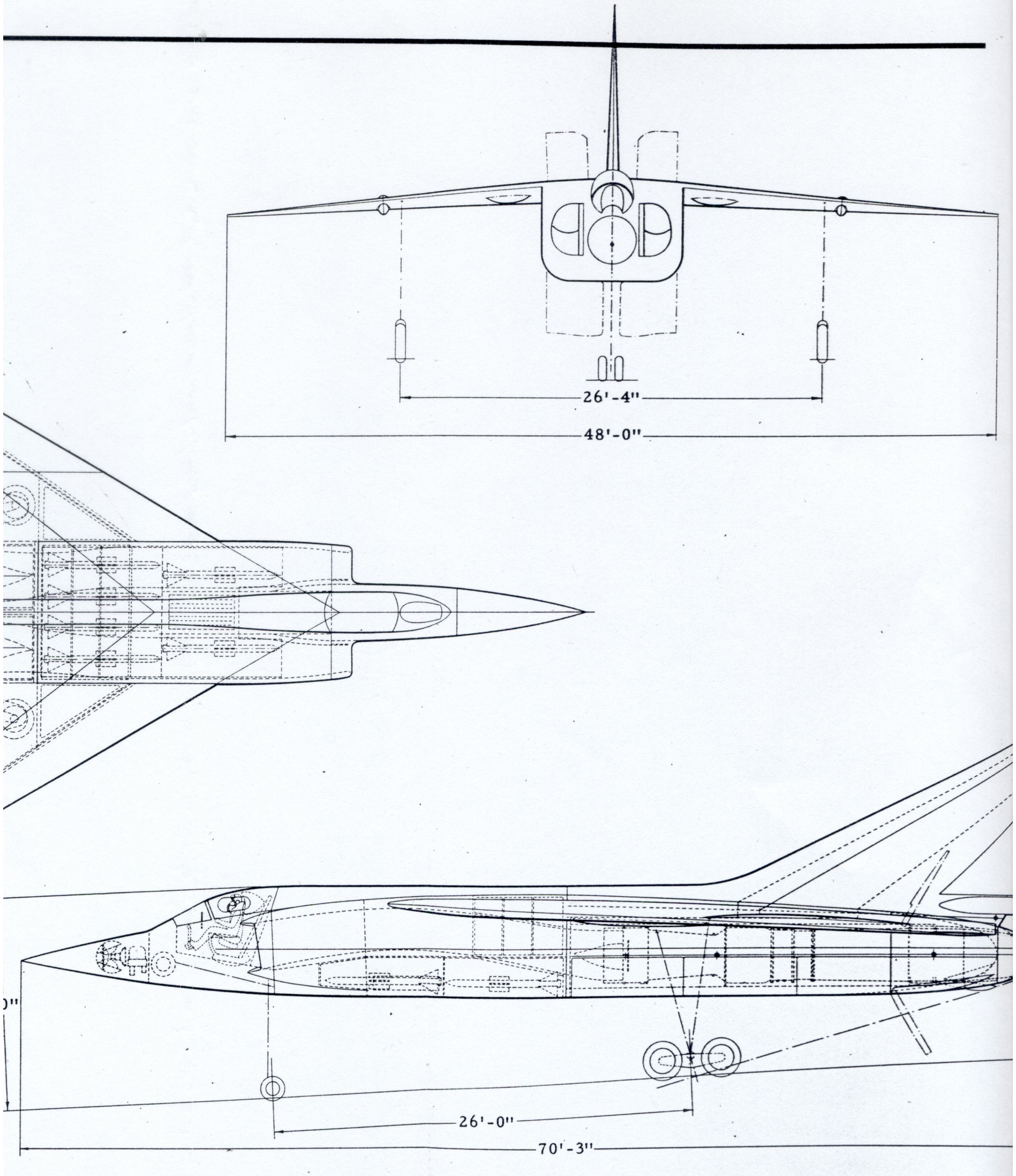
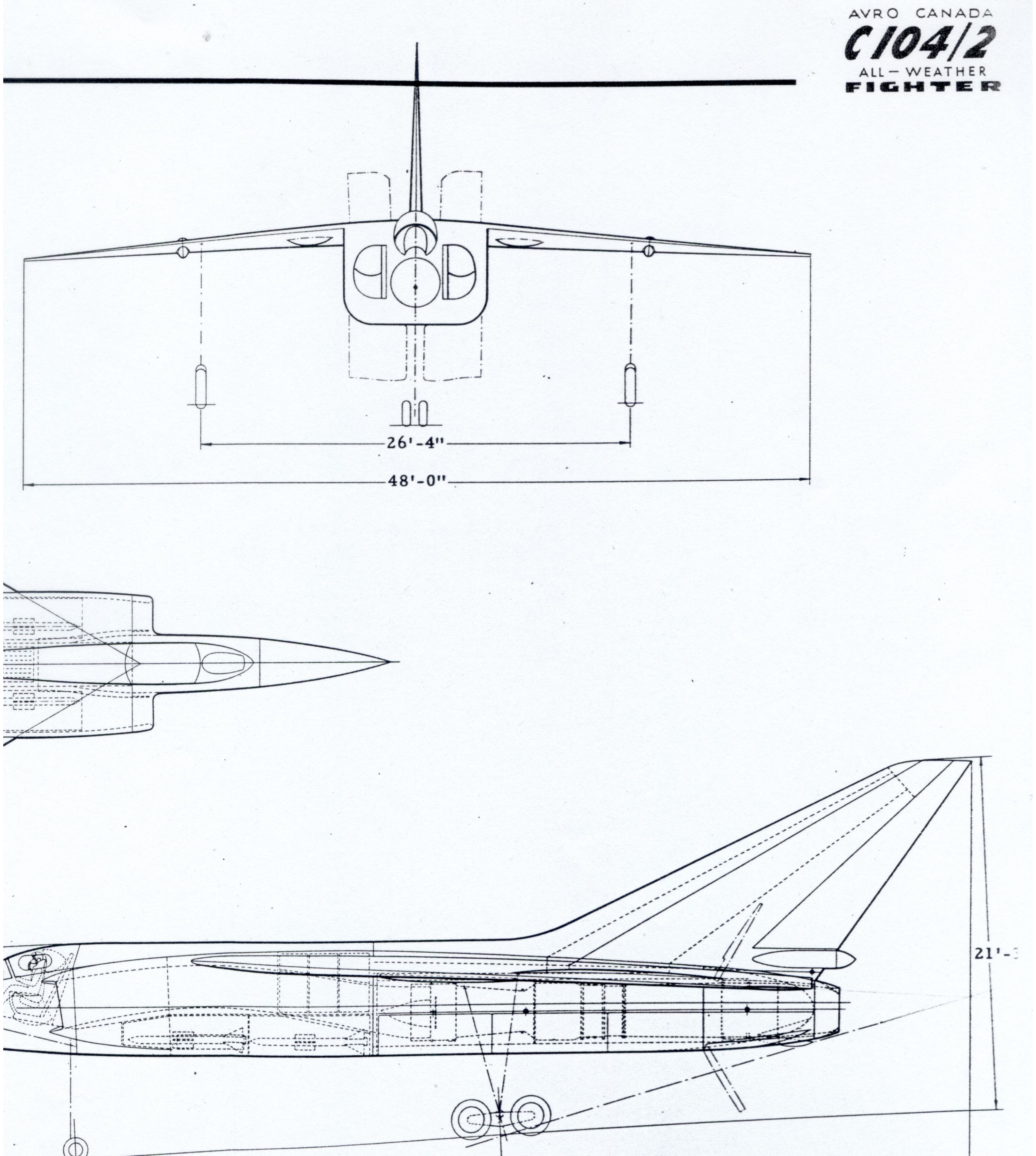



FIG. 1 3 VIEW G.A. OF AIRPLANE




G. 1 3 VIEW G.A. OF AIRPLANE

MODEL DESIGNATION C104/2/D

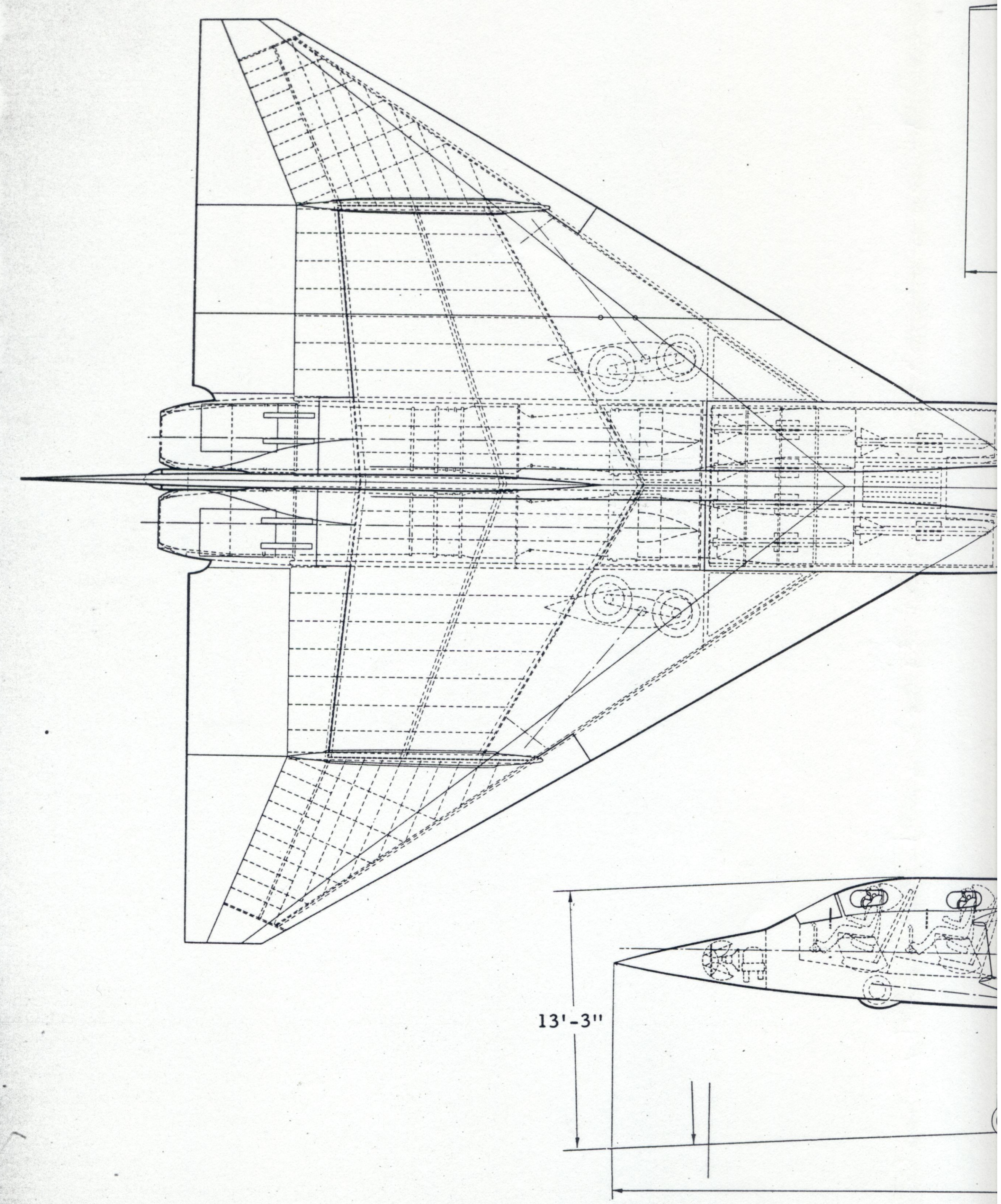





FIG. 36.

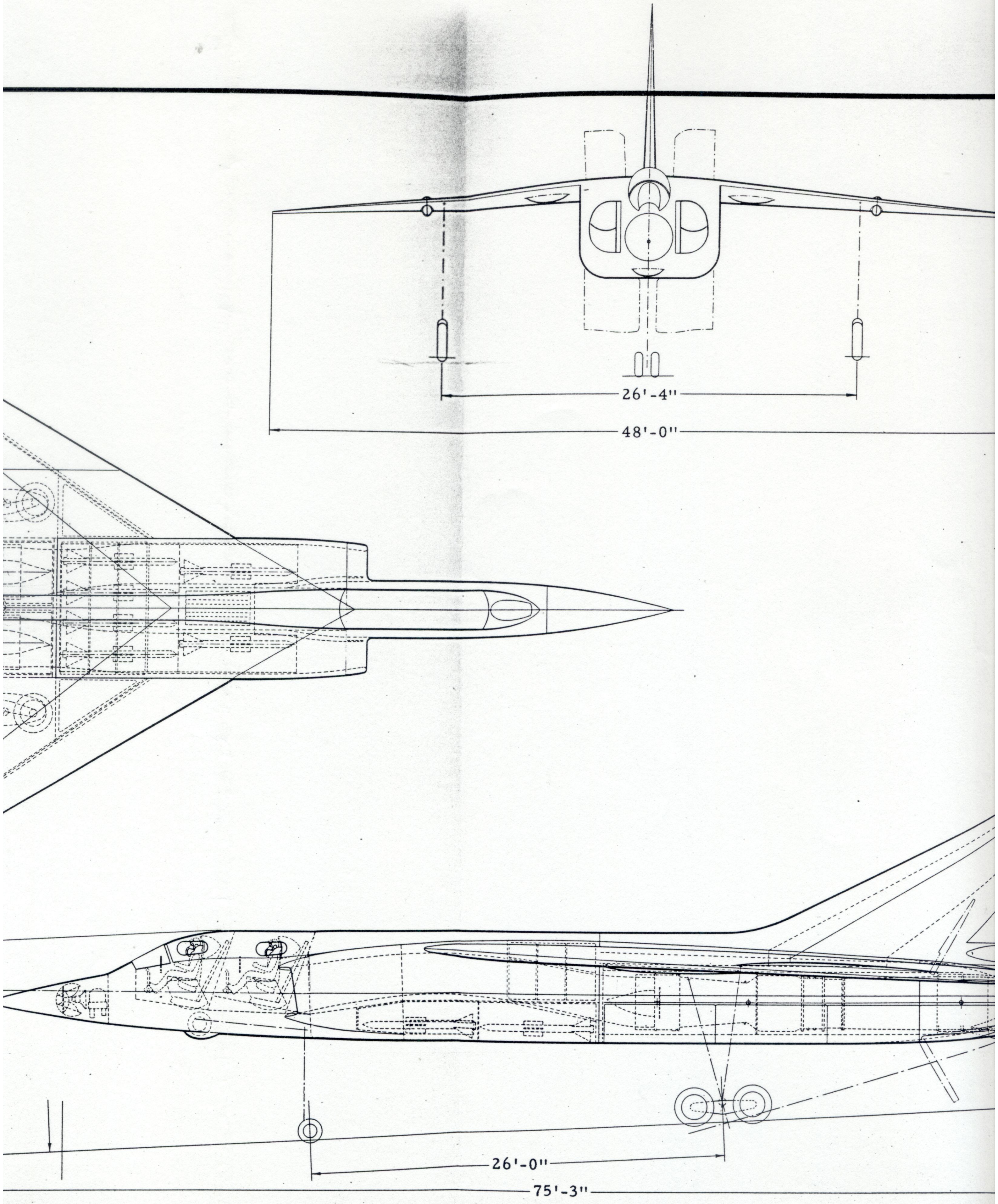
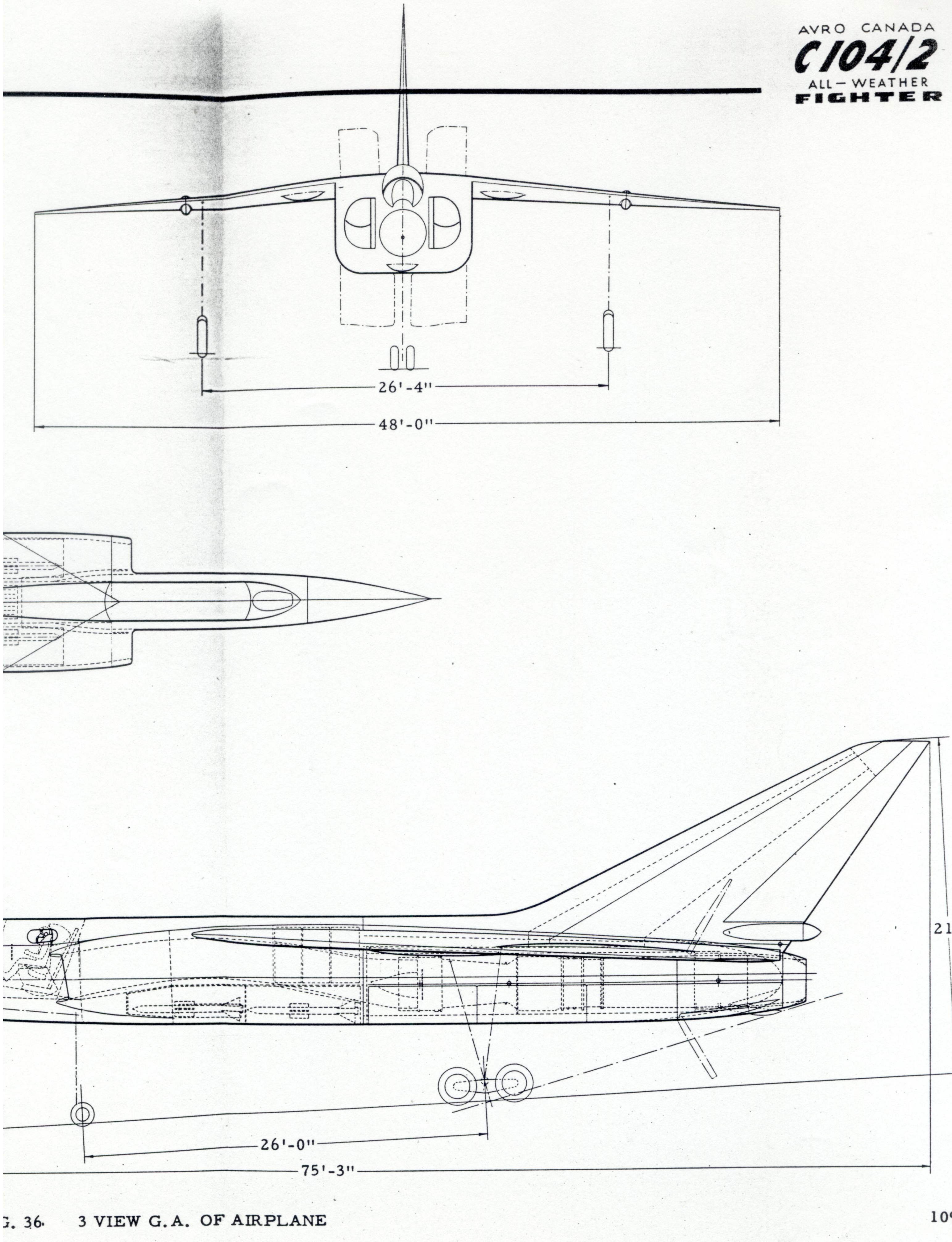



FIG. 36. 3 VIEW G.A. OF AIRPLANE




G. 36. 3 VIEW G.A. OF AIRPLANE