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SUPPLEMENT 1
PWAC-275
ADVANCED NUCLEAR TURBOJET
POWERPLANT CHARACTERISTICS SUMMARY
FOR SUPERSONIC AIRCRAFT
May 19, 1959

CONTRACT
AT(11-1)-229

Issued
May 27, 1959

FLY SHEET

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ADVANCED NUCLEAR TURBOJET POWERPLANT CHARACTERISTICS SUMMARY FOR SUPERSONIC AIRCRAFT

Written By: J. LARSON

[redacted]

May 22, 1959

AUTHORIZED CLASSIFIER — May 22, 1959
DATE

[redacted]

A. INTRODUCTION AND SUMMARY

The powerplant characteristics previously described in PWAC-275 were based on the use of low compressor pressure ratio nuclear turbojet engines equipped with interburners but without afterburners. The performance of an afterburning version of the same engine is presented in Section B of this supplement.

The engine selection for the previous report and for Section B of this supplement was based on best engine performance at Mach No. 3 on nuclear heat alone. For this reason a low compression turbojet engine was selected. However, it is desirable that the nuclear data in report PWAC-275 be useful for both subsonic and supersonic missions. Therefore, the engine performance has been computed for a nuclear conversion of the Pratt & Whitney Aircraft J-58 turbojet engine which has a higher compressor pressure ratio. The performance of this engine is outlined in Section C of this supplement.

B. LOW COMPRESSION TURBOJET ENGINE AFTERBURNING PERFORMANCE

The engine envelope and estimated engine performance of the advanced nuclear turbojet powerplant described in PWAC-275, but operating with a chemical afterburner, is presented in Figs 1 to 5. The envelope of the engine equipped with an afterburner is illustrated in Fig 1. This engine is basically the same 330 pounds per second design corrected airflow and 5 to 1 compressor pressure ratio engine described in the original report. The addition of the afterburner to this non-afterburning engine results in a net weight increase of 930 pounds for each turbojet unit.

The estimated net thrust and chemical fuel flow are plotted in Figs 2 and 3 as functions of flight condition for nuclear chemical operation with maximum afterburning. The airflow and reactor power for these flight conditions are the same as for non-afterburning, nuclear-chemical engine operation as shown in Figs 15 and 16 of PWAC-275.

The thrust specific fuel consumption for nuclear-chemical operation with varying fuel flow in the afterburner is plotted in Figs 4 and 5 as a function of net thrust. Performance in Fig 4 is presented for Mach number 0.95 and sea level. Performance in Fig 5 is presented for Mach number 3.0 and 65,000 feet altitude.

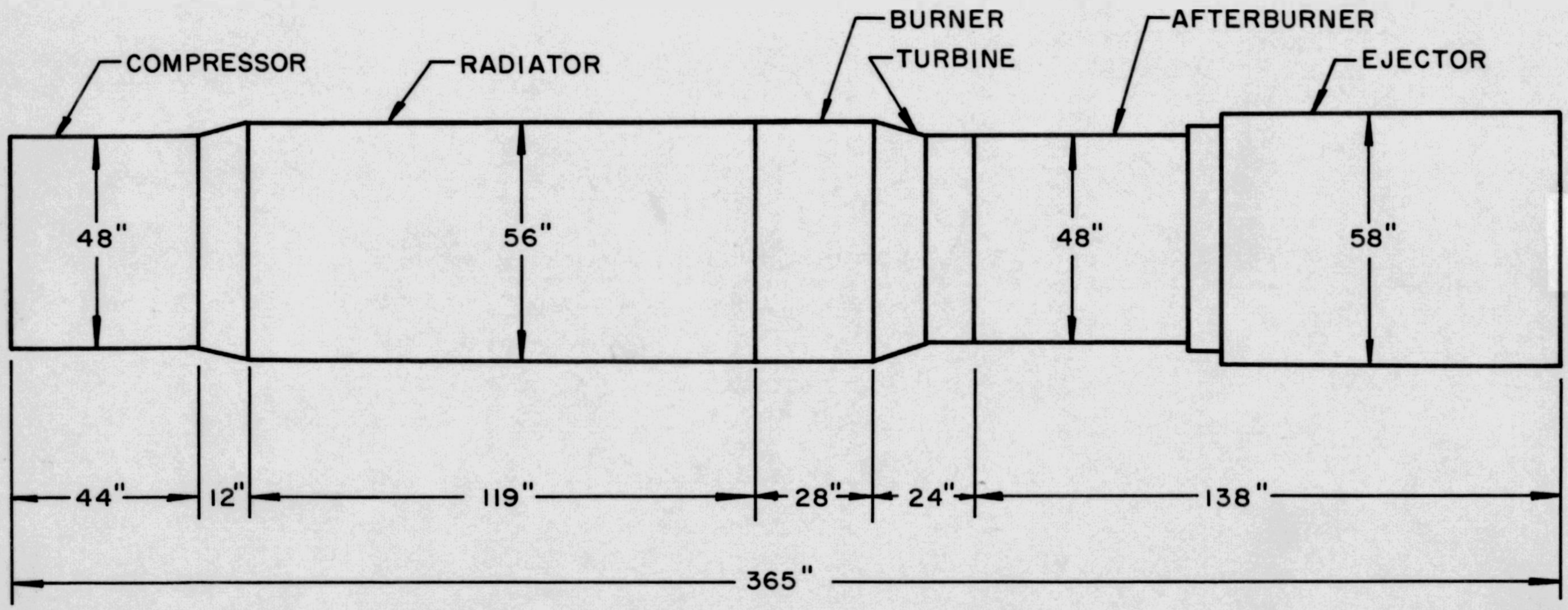
C. PRATT & WHITNEY AIRCRAFT J-58 TURBOJET ENGINE PERFORMANCE

The estimated engine performance of a powerplant consisting of the Pratt & Whitney Aircraft J-58 turbojet engine substituted for the low compressor pressure ratio engine in PWAC-275 is presented in Figs 6 to 14. This engine uses the same lithium to air radiator as the engine described in PWAC-275 and is fitted with both interburners and afterburners. The engine design corrected airflow is 300 pounds per second and the compressor pressure ratio is 8 to 1. Six of these engines are required for the nuclear powerplant.

The weight of the Pratt & Whitney Aircraft J-58 turbojet engine, exclusive of radiator is 5,200 pounds with afterburner and 4,300 pounds without afterburner. The lithium to air radiator used with this engine weighs 7,000 pounds. The engine envelope is approximately the same as that of the low compression turbojet engine outlined in Fig 1.

The estimated net thrust, compressor airflow and reactor power for operation on nuclear heat alone, is presented on a per engine basis in Figs 6 to 8. Performance for nuclear heat plus maximum interburning is presented in Figs 9 and 10. Performance for both maximum and minimum afterburning is presented in Figs 11 to 14. The airflow and reactor power for nuclear chemical operation is approximately the same as for operation on nuclear heat alone as plotted in Figs 7 and 8. The nuclear chemical performance illustrated by these figures is based on the use of advanced chemical engines.

LOW COMPRESSION TURBOJET ENGINE ENVELOPE



SUPPLEMENT 1
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FIG 1

FIG 2

LOW COMPRESSION TURBOJET ENGINE

ESTIMATED NET THRUST

NUCLEAR CHEMICAL OPERATION WITH
MAXIMUM AFTERBURNING

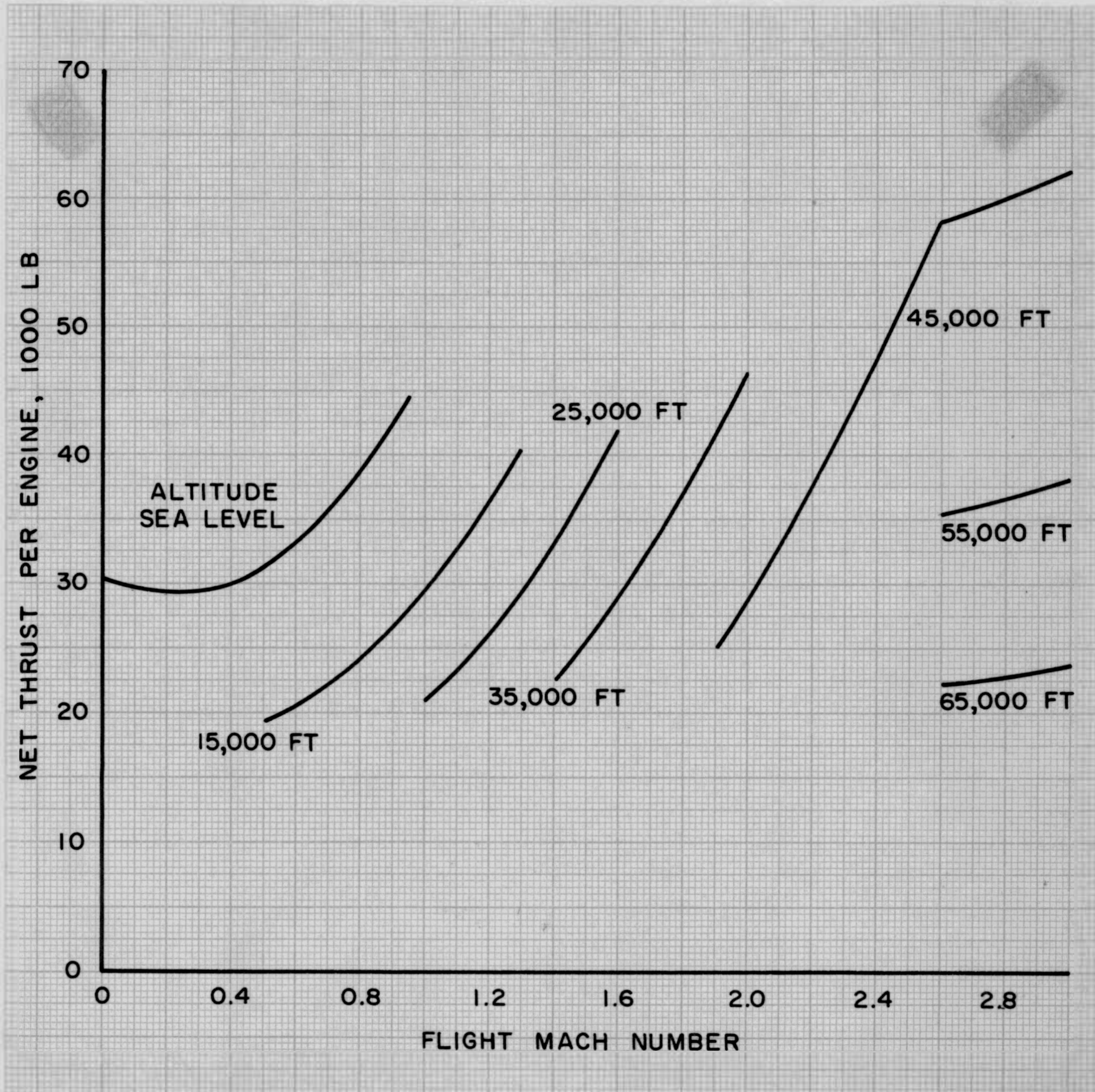


FIG 3

LOW COMPRESSION TURBOJET ENGINE

ESTIMATED CHEMICAL FUEL FLOW

NUCLEAR CHEMICAL OPERATION WITH
MAXIMUM AFTERBURNING

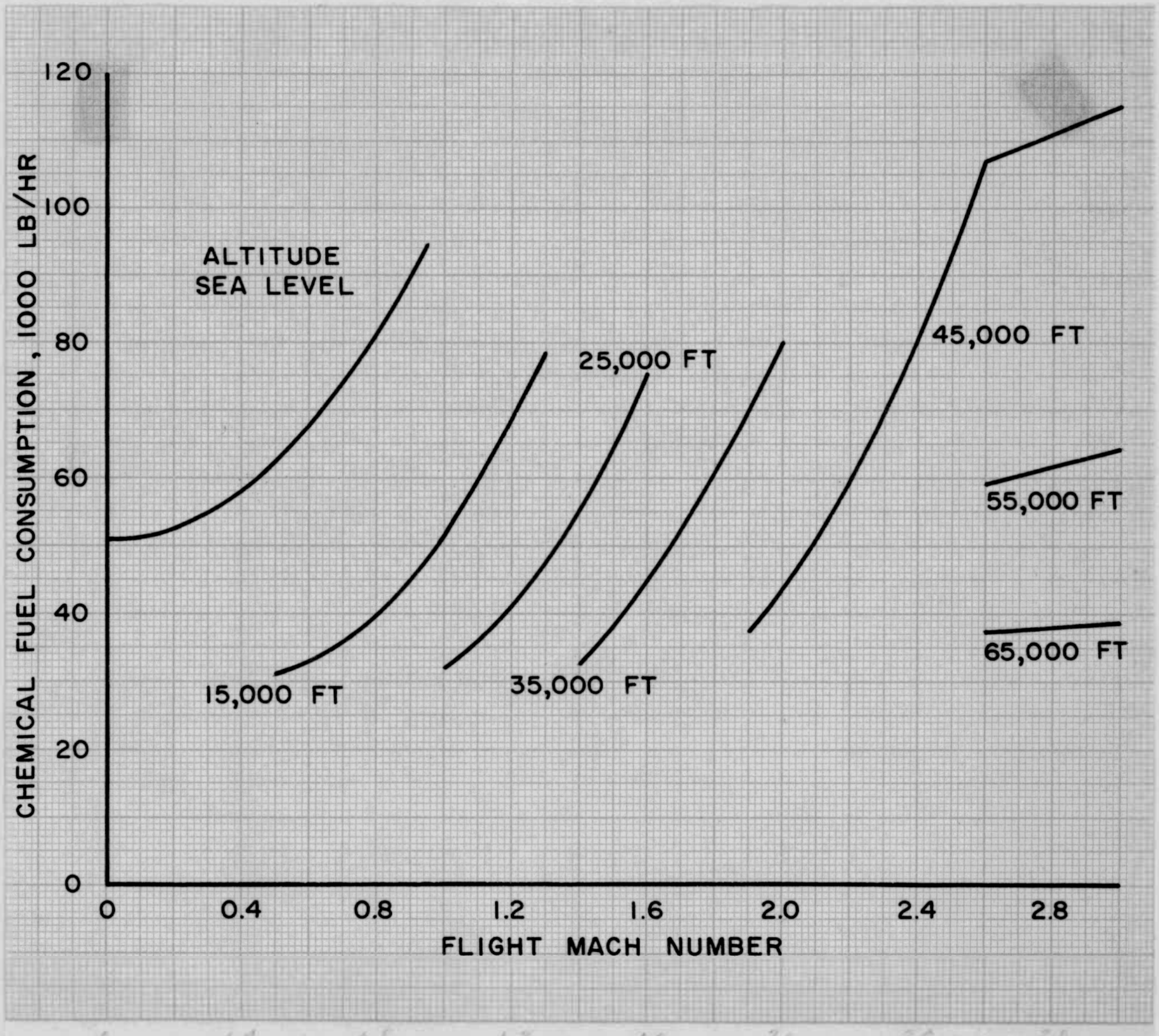


FIG 4

LOW COMPRESSION TURBOJET ENGINE

THRUST SPECIFIC FUEL CONSUMPTION

MACH NO. 0.95 AND SEA LEVEL
545 LB/SEC AIRFLOW

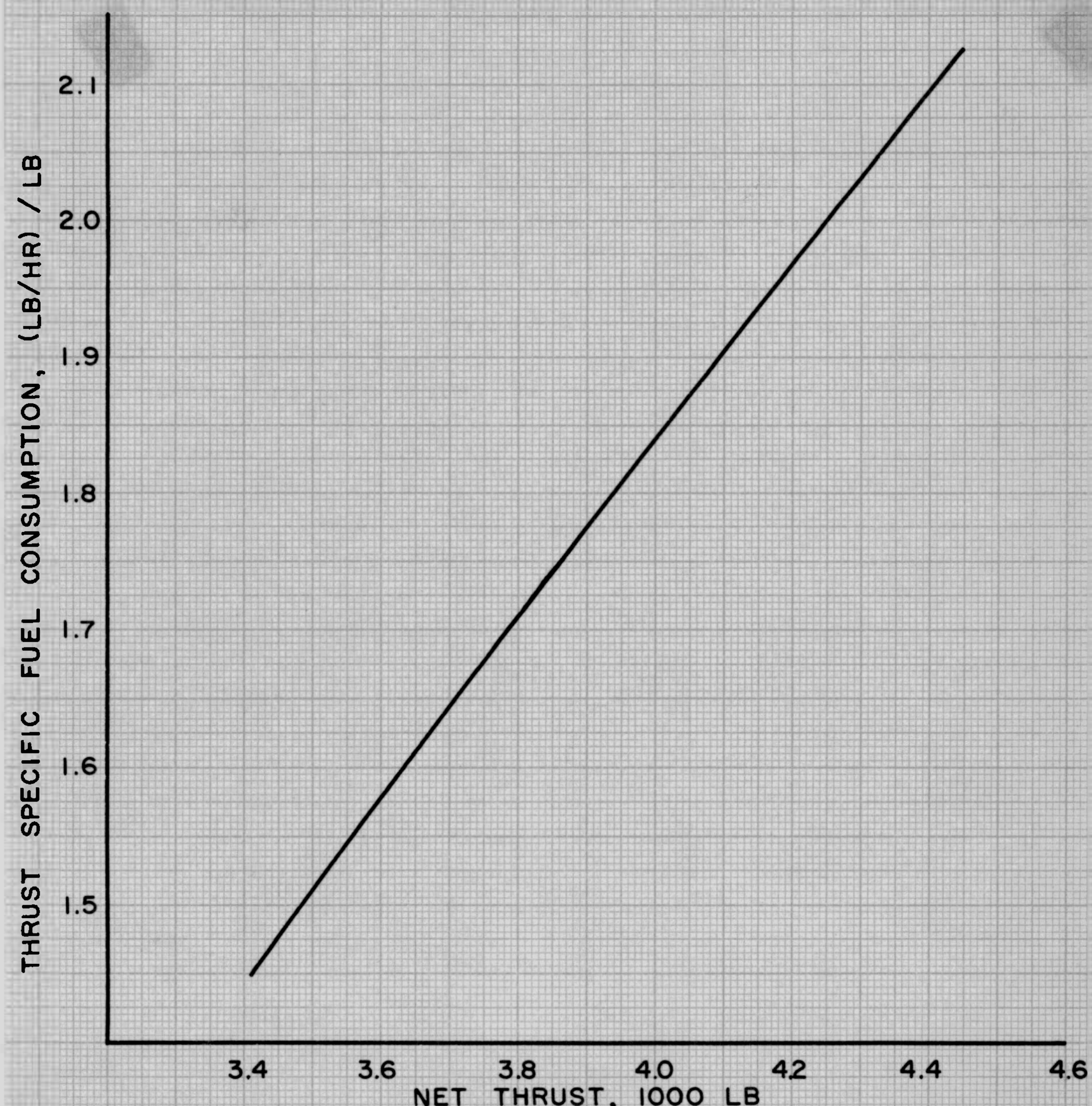
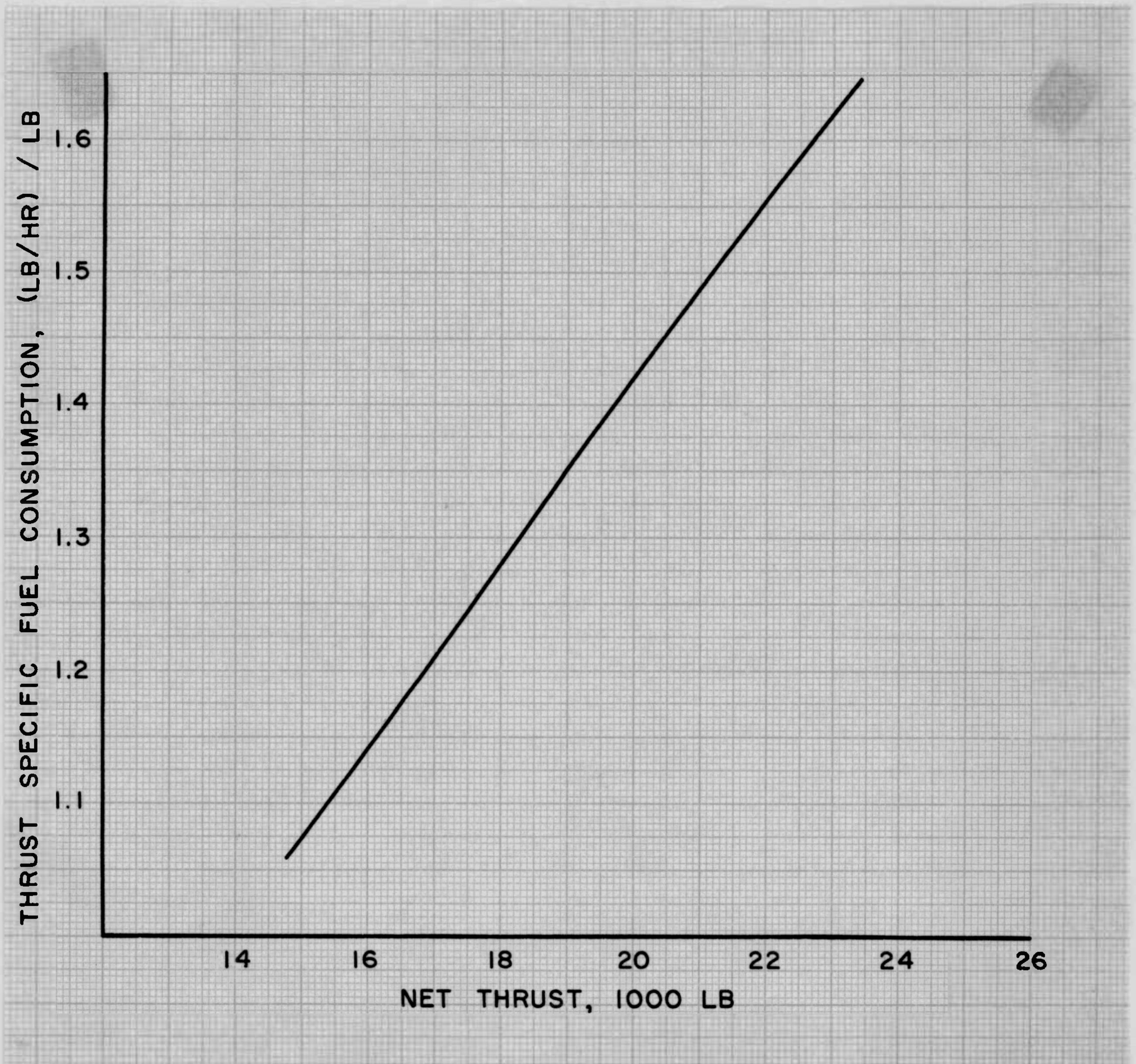


FIG 5

LOW COMPRESSION TURBOJET ENGINE

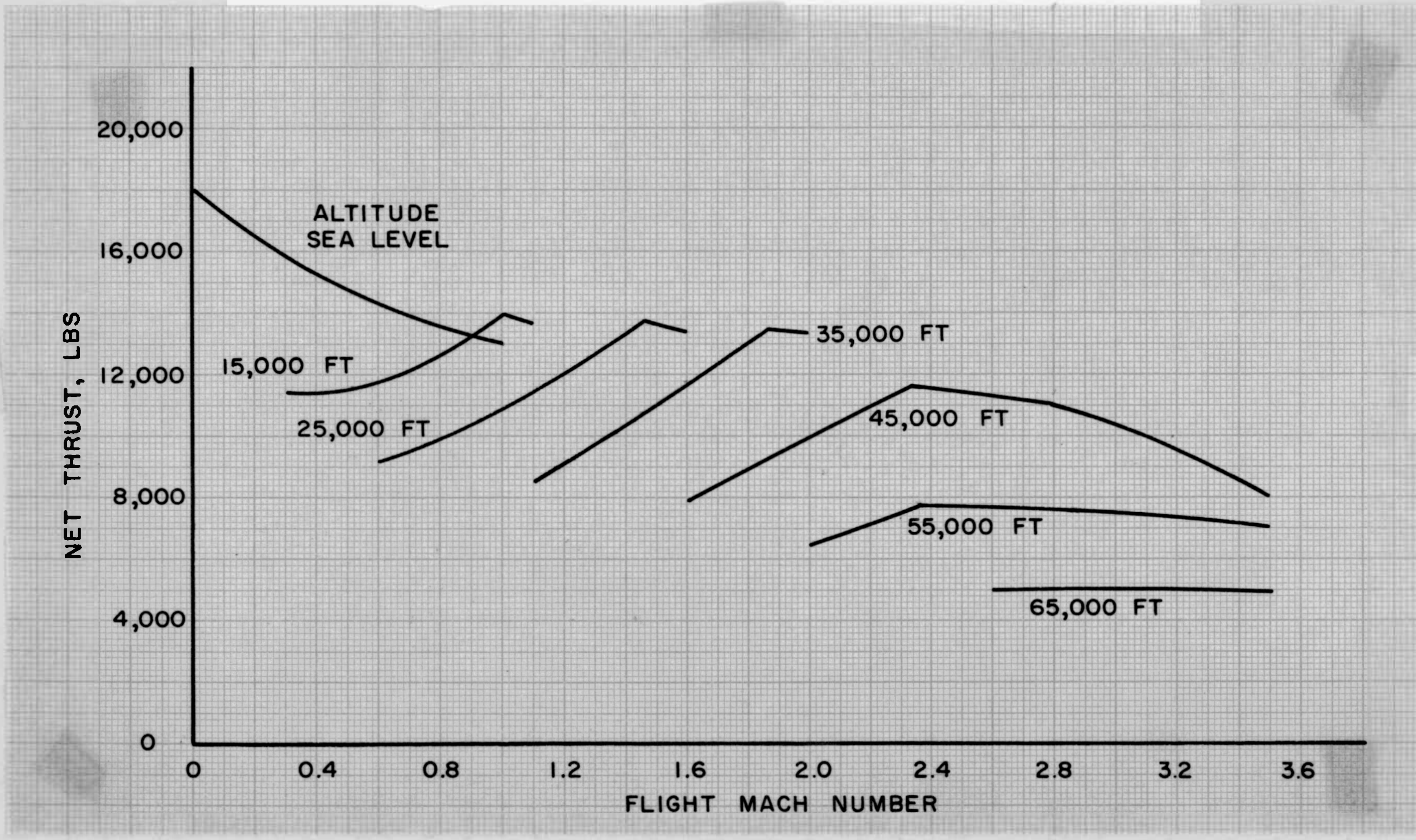
THRUST SPECIFIC FUEL CONSUMPTION

MACH NO. 3.0 AND 65,000 FT ALTITUDE
281 LB/SEC AIRFLOW



J-58 TURBOJET ENGINE ESTIMATED NET THRUST

NUCLEAR HEAT ONLY OPERATION



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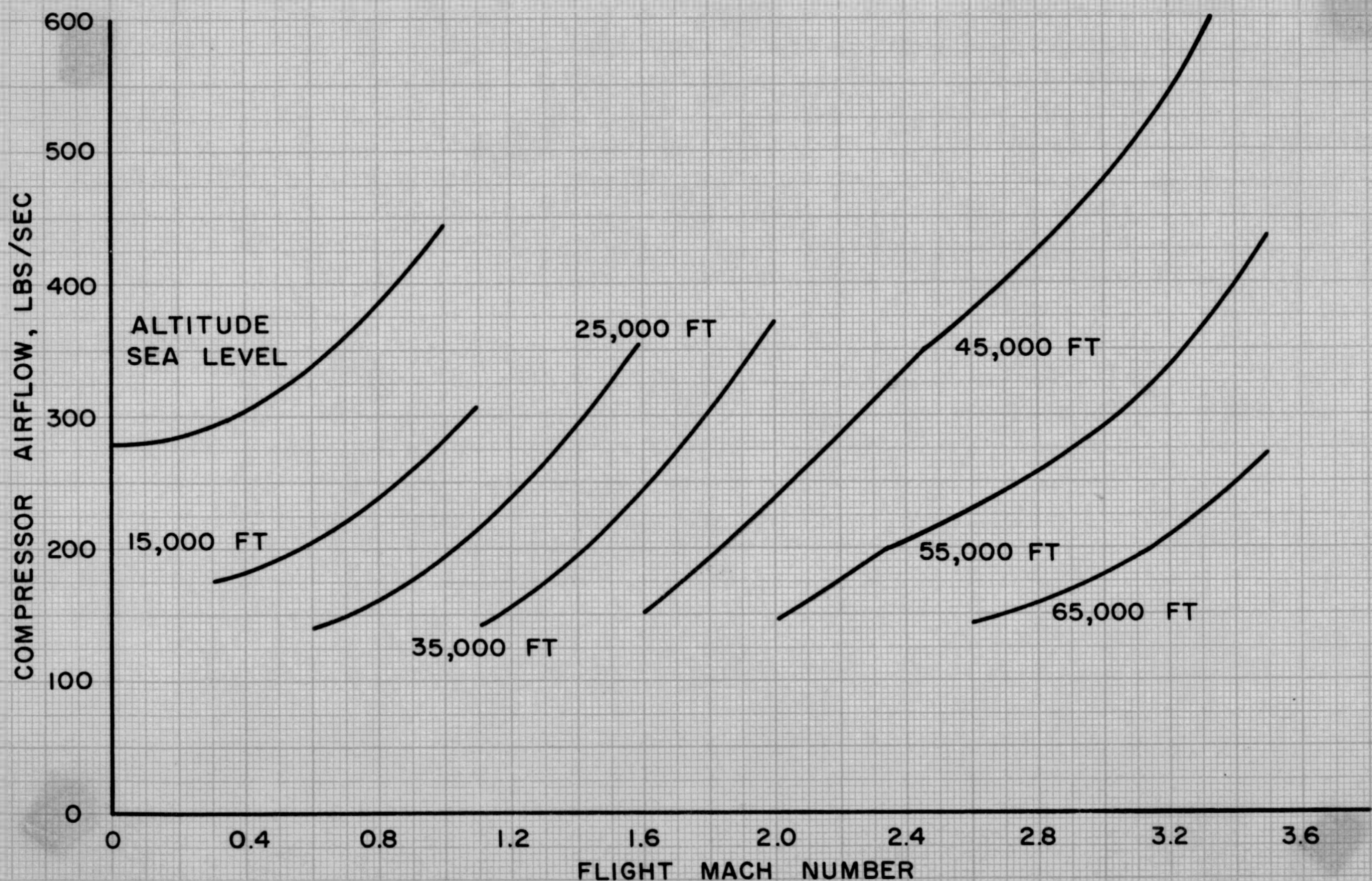
J-58 TURBOJET ENGINE ESTIMATED COMPRESSOR AIRFLOW



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J-58 TURBOJET ENGINE ESTIMATED REACTOR POWER

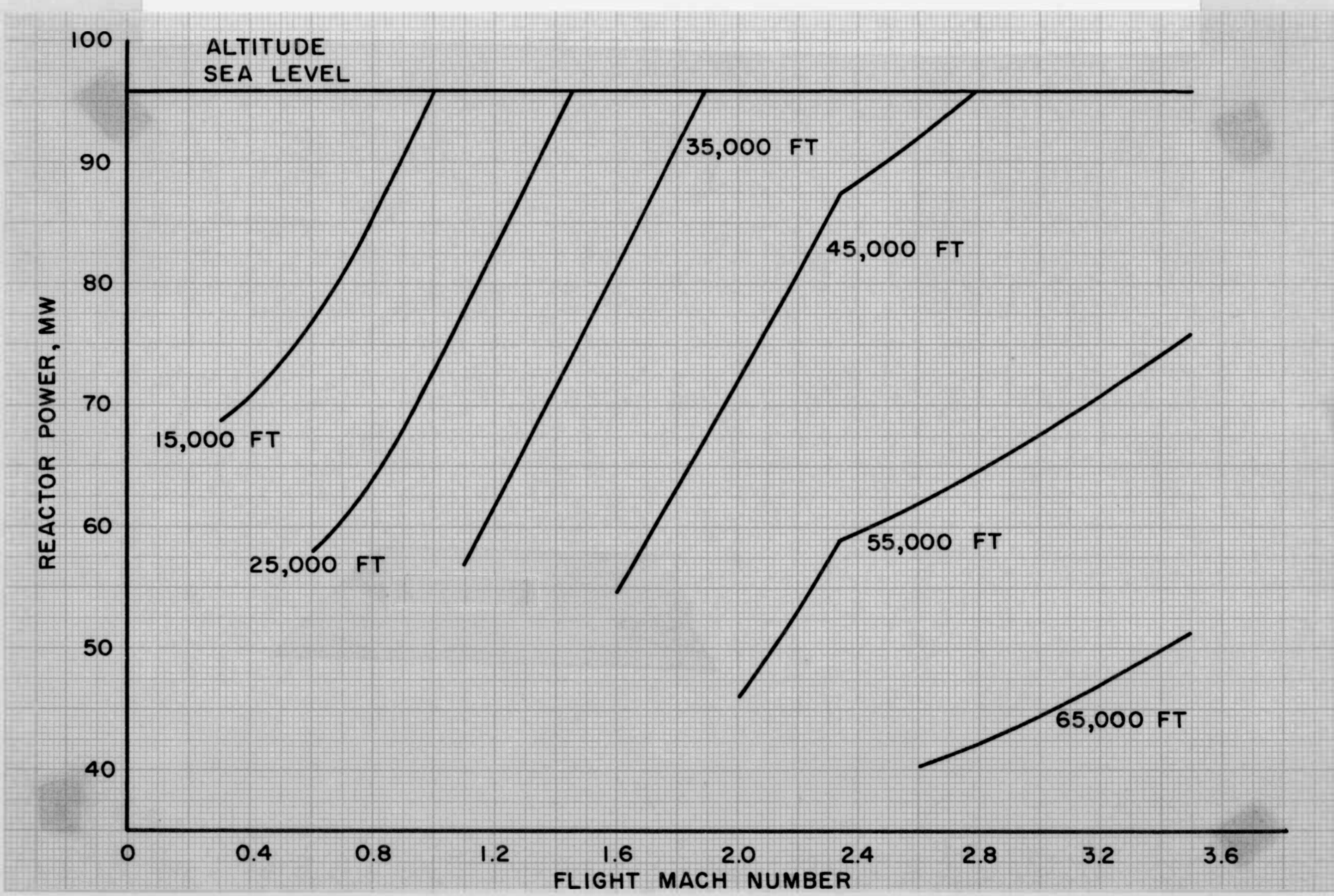

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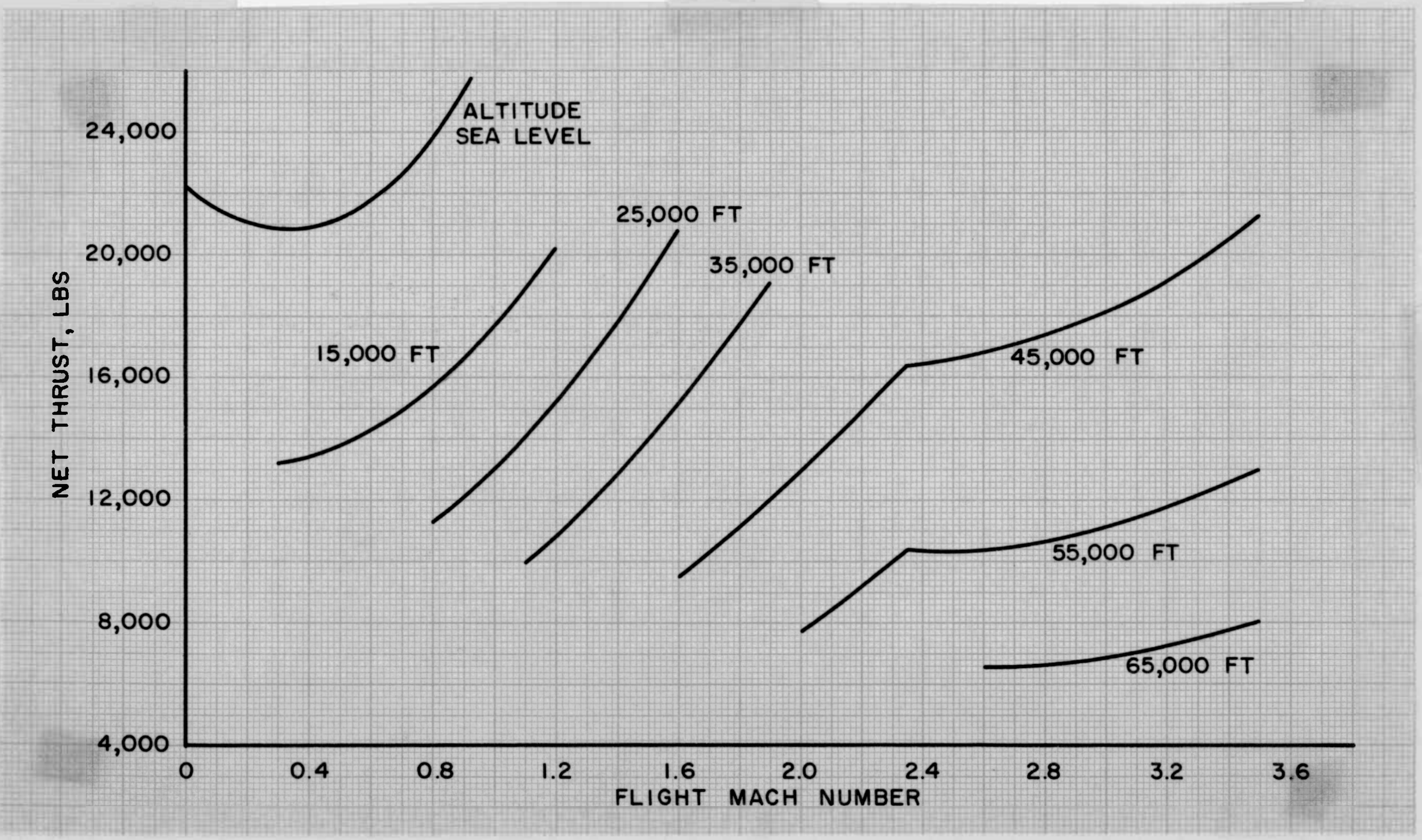
FIG 8

J-58 TURBOJET ENGINE ESTIMATED NET THRUST

NUCLEAR HEAT PLUS CHEMICAL INTERBURNING



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J-58 TURBOJET ENGINE ESTIMATED CHEMICAL FUEL FLOW

NUCLEAR HEAT PLUS CHEMICAL INTERBURNING

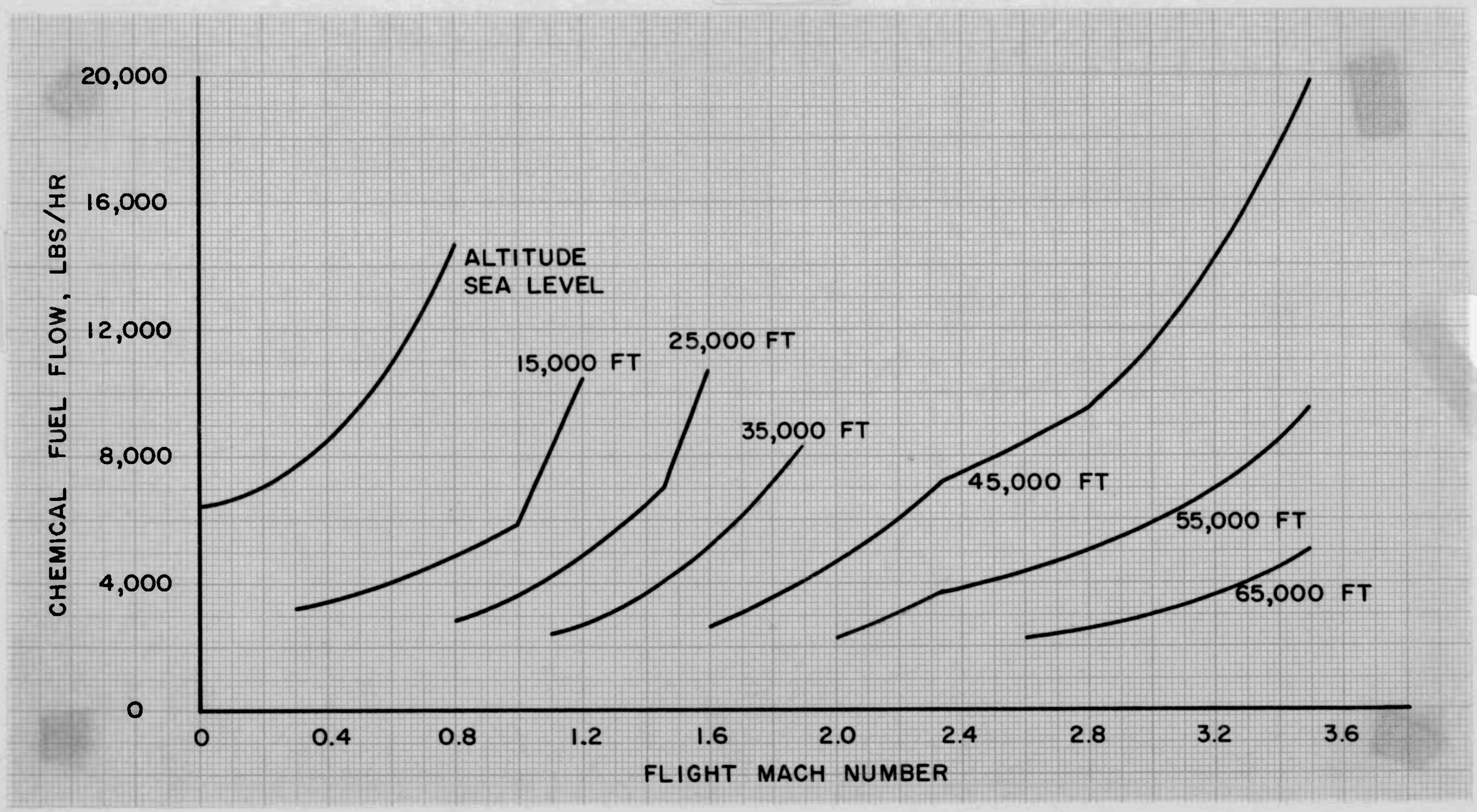

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FIG 10

J-58 TURBOJET ENGINE ESTIMATED NET THRUST

NUCLEAR CHEMICAL OPERATION WITH MAXIMUM AFTERBURNING

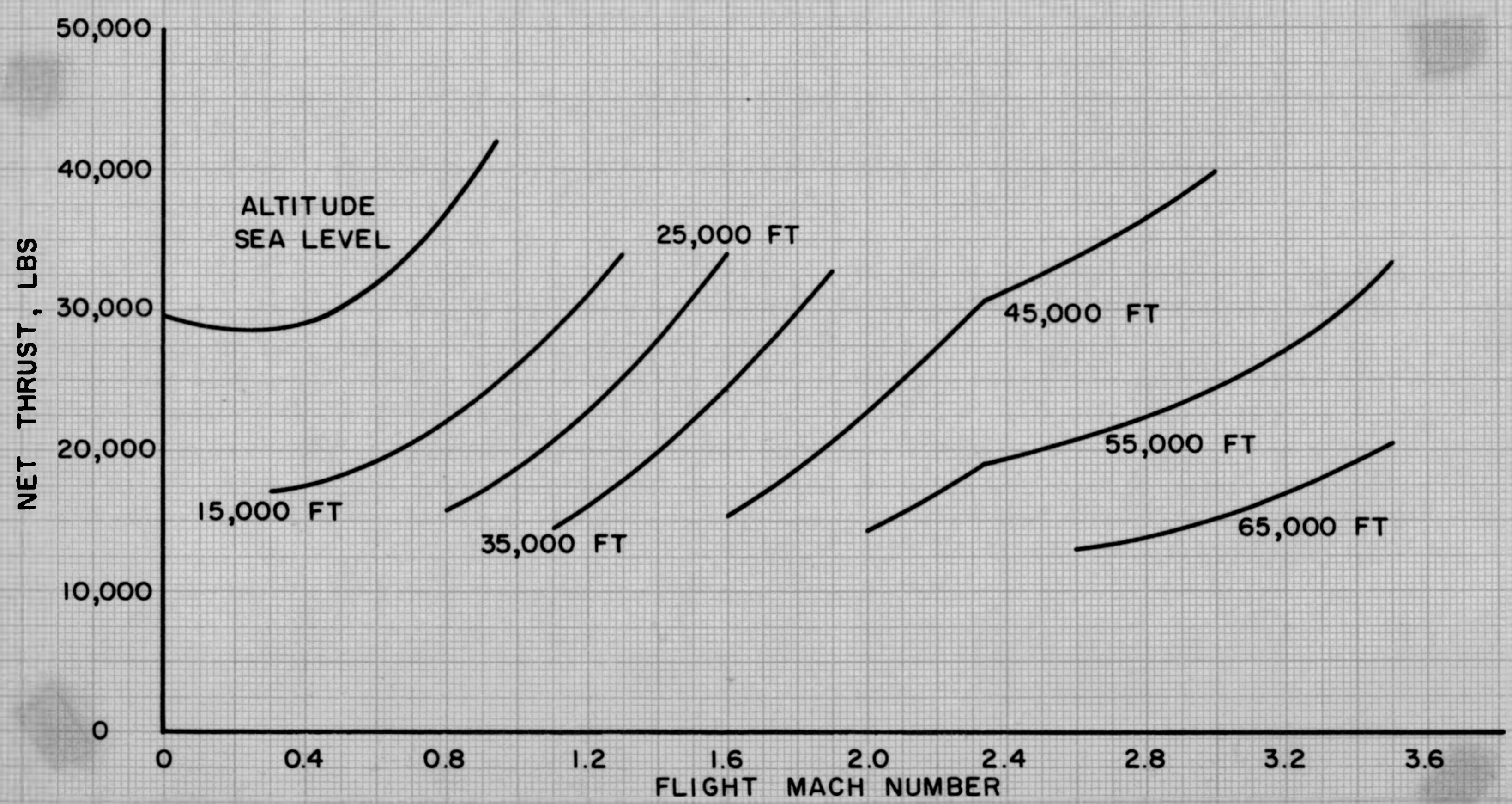

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FIG 11

J-58 TURBOJET ENGINE ESTIMATED CHEMICAL FUEL FLOW

NUCLEAR CHEMICAL OPERATION WITH MAXIMUM AFTERBURNING

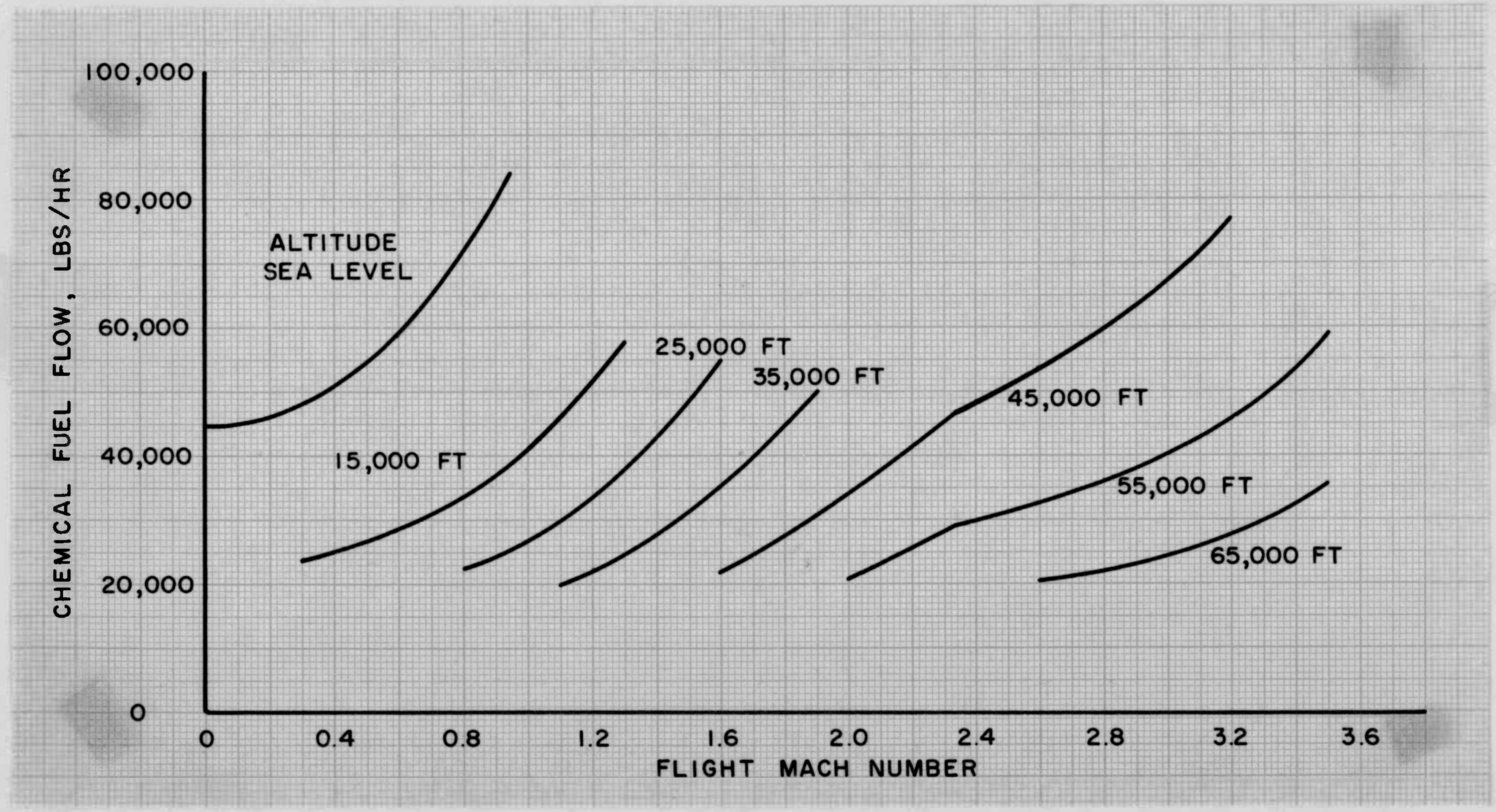

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FIG 12

J-58 TURBOJET ENGINE ESTIMATED NET THRUST

NUCLEAR CHEMICAL OPERATION WITH MINIMUM AFTERBURNING

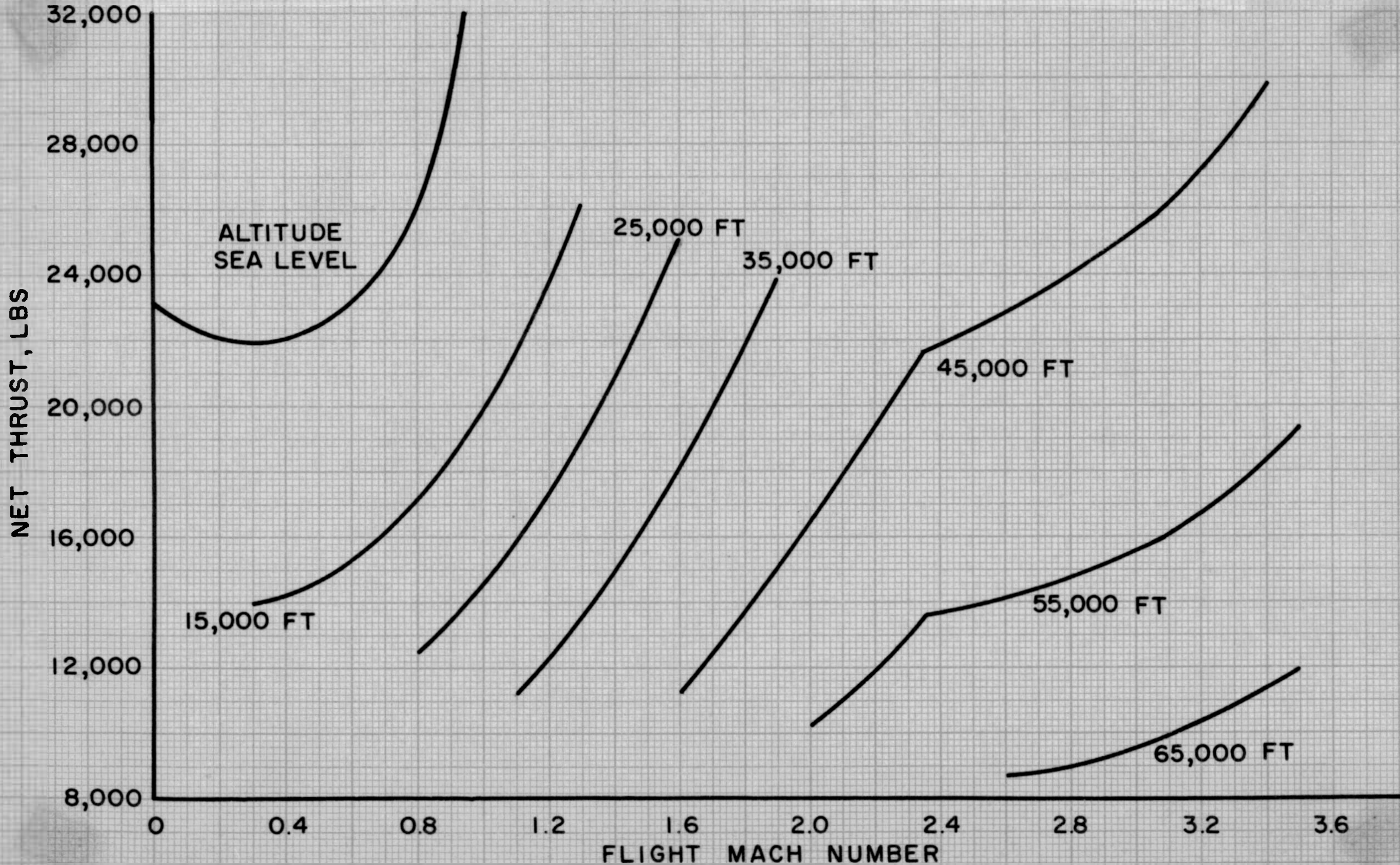

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FIG 13

J-58 TURBOJET ENGINE ESTIMATED CHEMICAL FUEL FLOW

NUCLEAR CHEMICAL OPERATION WITH MINIMUM AFTERBURNING

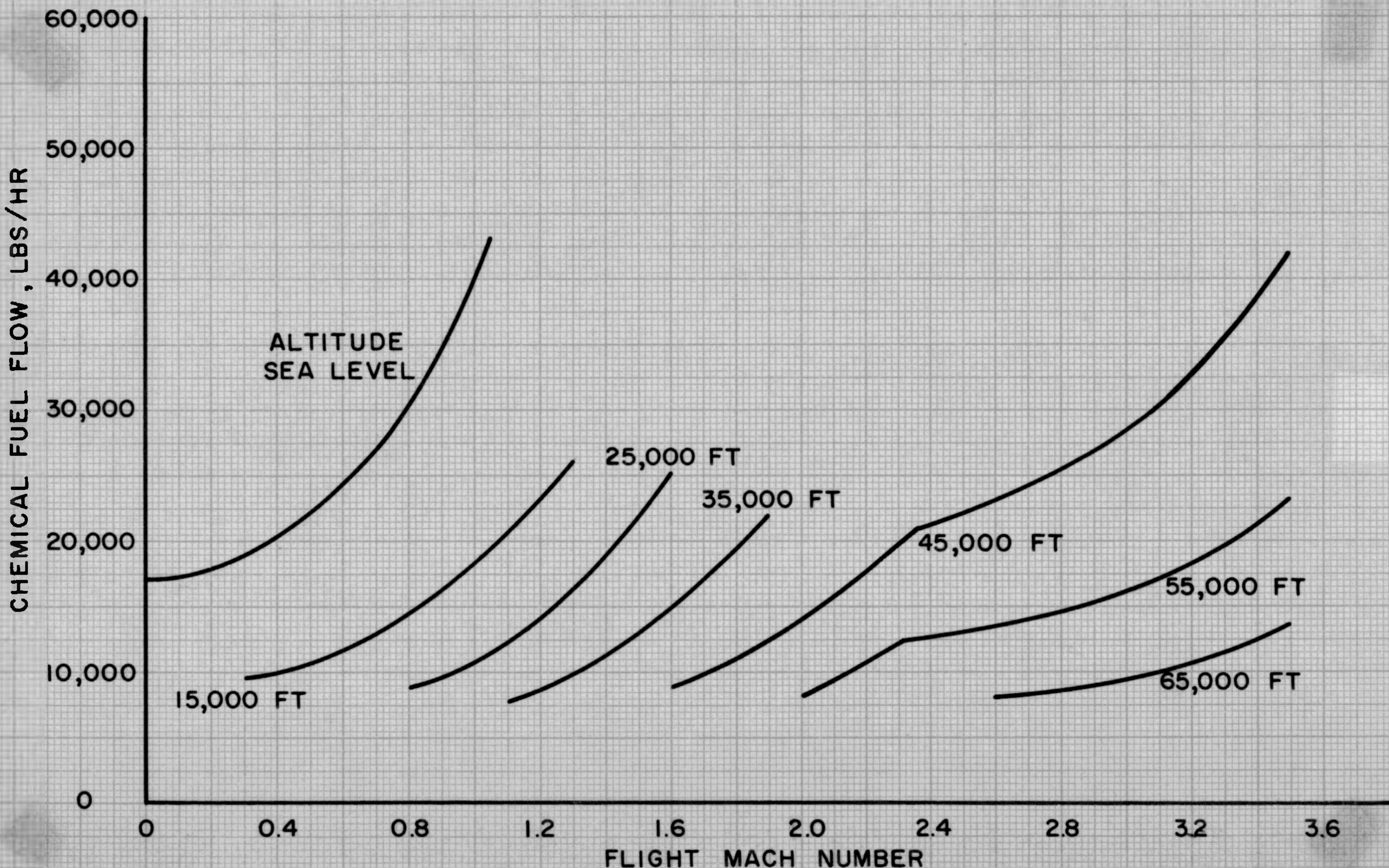

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FIG 14