

AVRO AIRCRAFT LIMITED
PERIODIC PERFORMANCE REPORT 15

PERFORMANCE OF THE ARROW 2
APPENDIX 1

SECRET

DECEMBER 1958



AVRO AIRCRAFT LIMITED

MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

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AIRCRAFT: ARROW 2

REPORT NO: Appendix I
to Periodic Performance
Report No. 15

FILE NO: 72/PERF/36

NO. OF SHEETS _____

TITLE:

APPENDIX 1 TO PERIODIC PERFORMANCE REPORT No. 15

PREPARED BY

Performance Group

R.L. Rose

DATE DEC. 1958

RECOMMENDED
FOR APPROVAL

[Signature]

DATE Dec/58

APPROVED

[Signature]

DATE Dec/58.

APPROVED
FOR RELEASE

[Signature]

DATE Dec/58.



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- 3 -

INDEXPAGE

Summary		4
Fig. 1A	Take-off (A/B Unlit) Time and Fuel to Unstick	5
1B	" " (A/B Lit) " " " " "	6
2A	S.L. Acceleration (A/B Unlit) to 527 Kts. Time, Fuel & Distance	7
2B	" " with Ventral Tank (A/B Unlit) to 527 Kts. Time, Fuel & Distance	8
2C	S.L. Acceleration (A/B Unlit) to 0.92M Time, Fuel & Distance	9
3	10,000 ft. Acceleration Time, Fuel & Distance	10
4A	.92M to 1.5M Acceleration Fuel	11
4B	" " " " Distance	12
4C	" " " " Time	13
5A	0.92M to 1.8M Acceleration Fuel	14
5B	" " " " Distance	15
5C	" " " " Time	16
6A	.92M to 2.0M Acceleration Fuel	17
6B	" " " " Distance	18
6C	" " " " Time	19
7A	R.O.C. at 527 Kts. (A/B Unlit) without Tank	20
7B	Climb " " " " Fuel	21
7C	" " " " " " Distance	22
7D	" " " " " " Time	23
8A	R.O.C. at 527 Kts. (A/B Unlit) with Tank	24
8B	Climb " " " " Fuel	25
8C	" " " " " " Distance	26
8D	" " " " " " Time	27
9A	R.O.C. at .92M (A/B Lit)	28
9B	Climb " " " " Fuel	29
9C	" " " " " " Distance	30
9D	" " " " " " Time	31
10A	R.O.C. at 1.5M	32
10B	Climb " " Fuel	33
10C	" " " " Distance	34
10D	" " " " Time	35
11A	R.O.C. at 1.8M	36
11B	Climb " " Fuel	37
11C	" " " " Distance	38
11D	" " " " Time	39
12A	R.O.C. at 2.0M	40
12B	Climb " " Fuel	41
12C	" " " " Distance	42
12D	" " " " Time	43
13	Subsonic Cruise no Tank NAMPP	44
14	" " with Tank NAMPP	45
15	" " Mach Number	46
16	" " at 10,000 ft. no Tank NAMPP	47
17	Supersonic " at M = 1.5	48
18	" " at M = 1.8	49
19	" " at M = 2.0	50
20	S.L. Loiter	51
21	Loiter at Altitude	52
22	Descent	53
23	Available Steady g's at Combat Weight	54



ARROW 2

APPENDIX 1 TO PERIODIC PERFORMANCE REPORT #15

Summary

The following are working performance curves of the Arrow 2 given in as general a form as possible, to enable the user to estimate additional mission profiles.

It should be noted that all Mach Numbers referred to in the following figures are True Mach Numbers.

The data given in this Appendix are based on the drag data given in Avro Report 71-2/Aero Data/17 (Revised Arrow drag based on preliminary flight test results) & propulsion data given in 72/Int. Aero/33 (Developed Iroquois Series 2 with 8050 maximum N_H rpm & developed afterburner).

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ARROW 2 A WITH 1000015 SERIES 2 ENGINES

TAKE OFF AT MILITARY THRUST (A/B OFF)
TO UNSTICK

S.L. STANDARD DAY (15°C)

TIME

FUEL

REF: DRAG 71-2/AERO DATA/7
PROPULSION 72/INT-AERO/53

80000

70000

60000

50000

AIRCRAFT WEIGHT AT START OF T.O. ~ LB.

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FIG. 1A

ARROW 2 WITH IROQUOIS SERIES 2 ENGINES

TAKE OFF AT MAXIMUM THRUST (A/B ON)
TO UNSTICK

SL STANDARD DAY (15°C)

FUEL

TIME

REF: DRAG 71-2 / AERO DATA / 17
PROPULSION 72 / INT. AERO / 35

80000

70000

60000

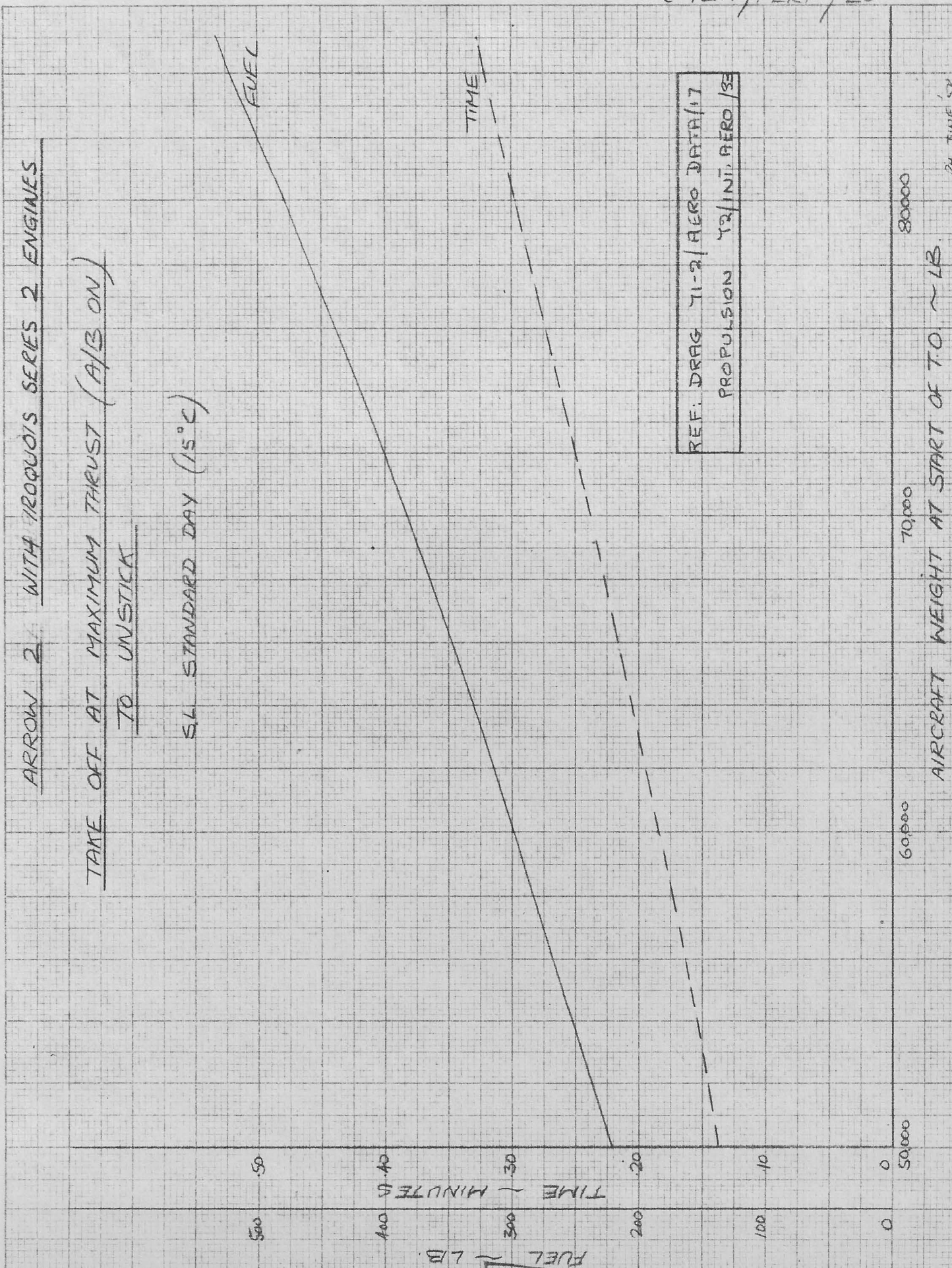
50000

AIRCRAFT WEIGHT AT START OF T.O. ~ LB.

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FIG. 1B



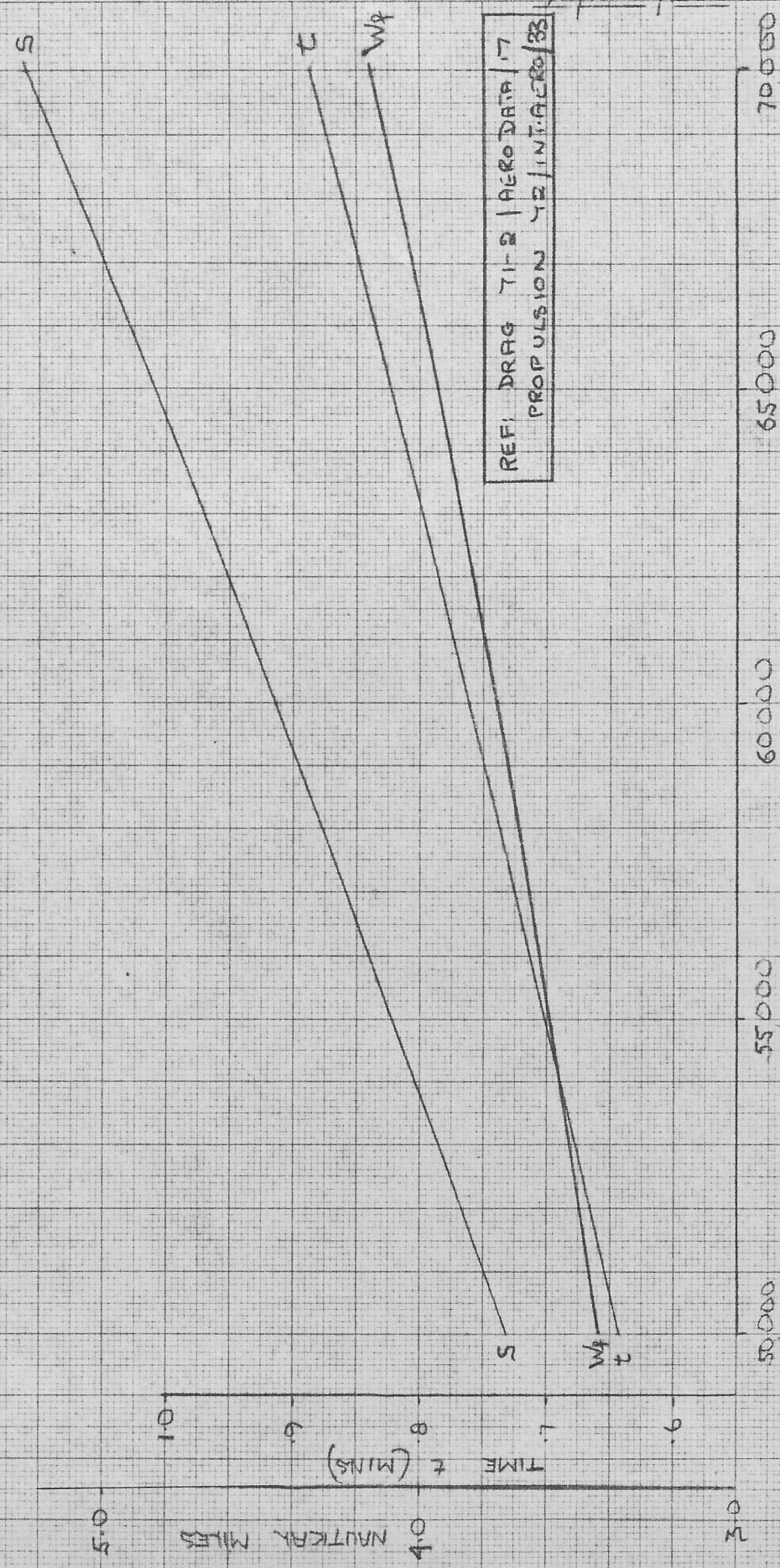
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Wt (lbs)
500
400

FIG. 2A

ARROW (2) (REVISED DRAG) MAX R.F.M. AB UNLIT

THRUST AS IN 72 INT AERO/33
TIME FUEL AND DISTANCE TO ACCELERATE
FROM UNSTICK TO 527 KTS SEA LEVEL

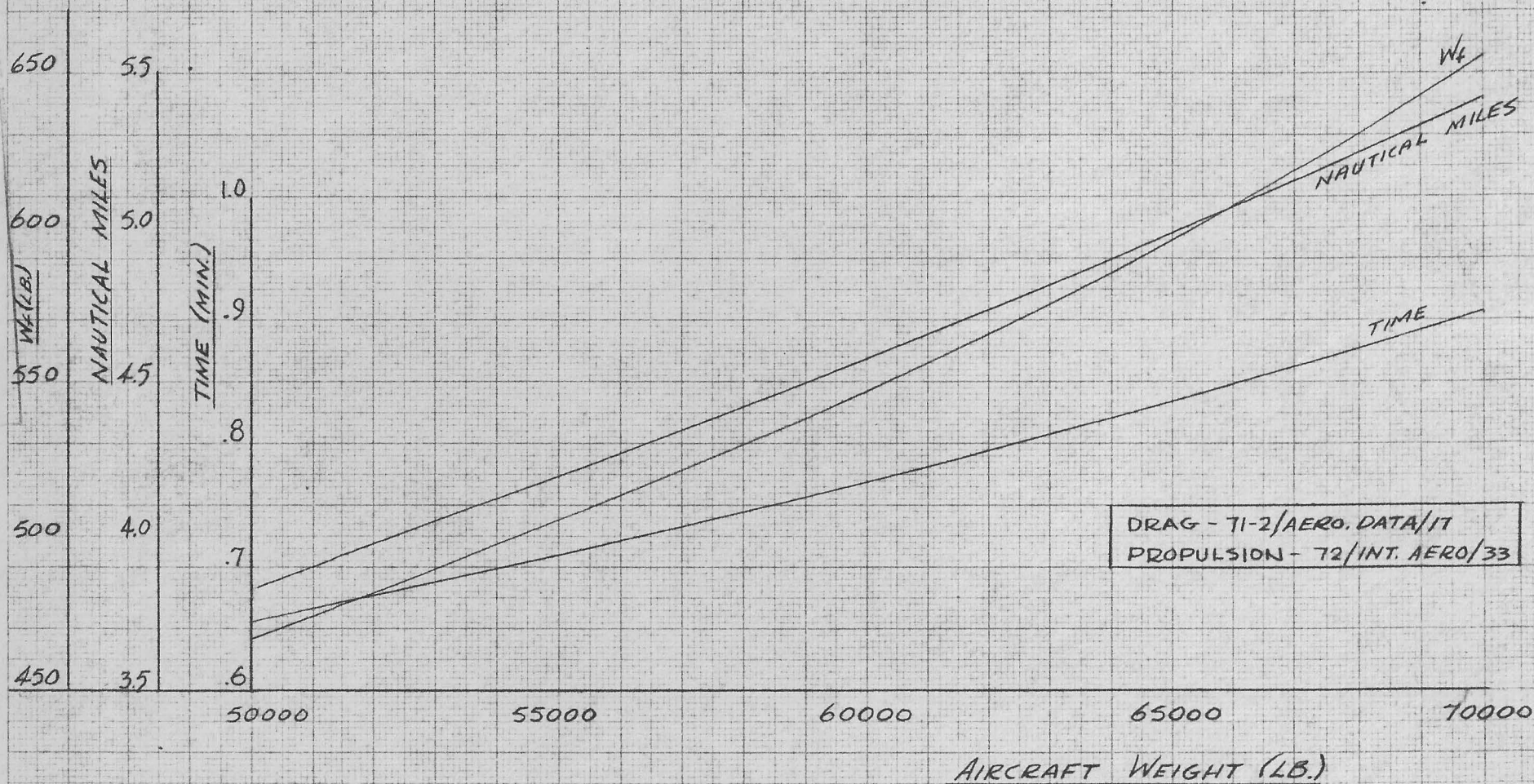


REF: DRAG 71-2 | AERO DATA 17
PROPULSION Y2/INT AERO/33

72/PERF/36

-7-

ARROW 2 (REVISED DRAG)
TIME, FUEL AND DISTANCE TO ACCELERATE
FROM UNSTICK TO 527 KTS. — SEA LEVEL
WITH VENTRAL TANK



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FIG. 28

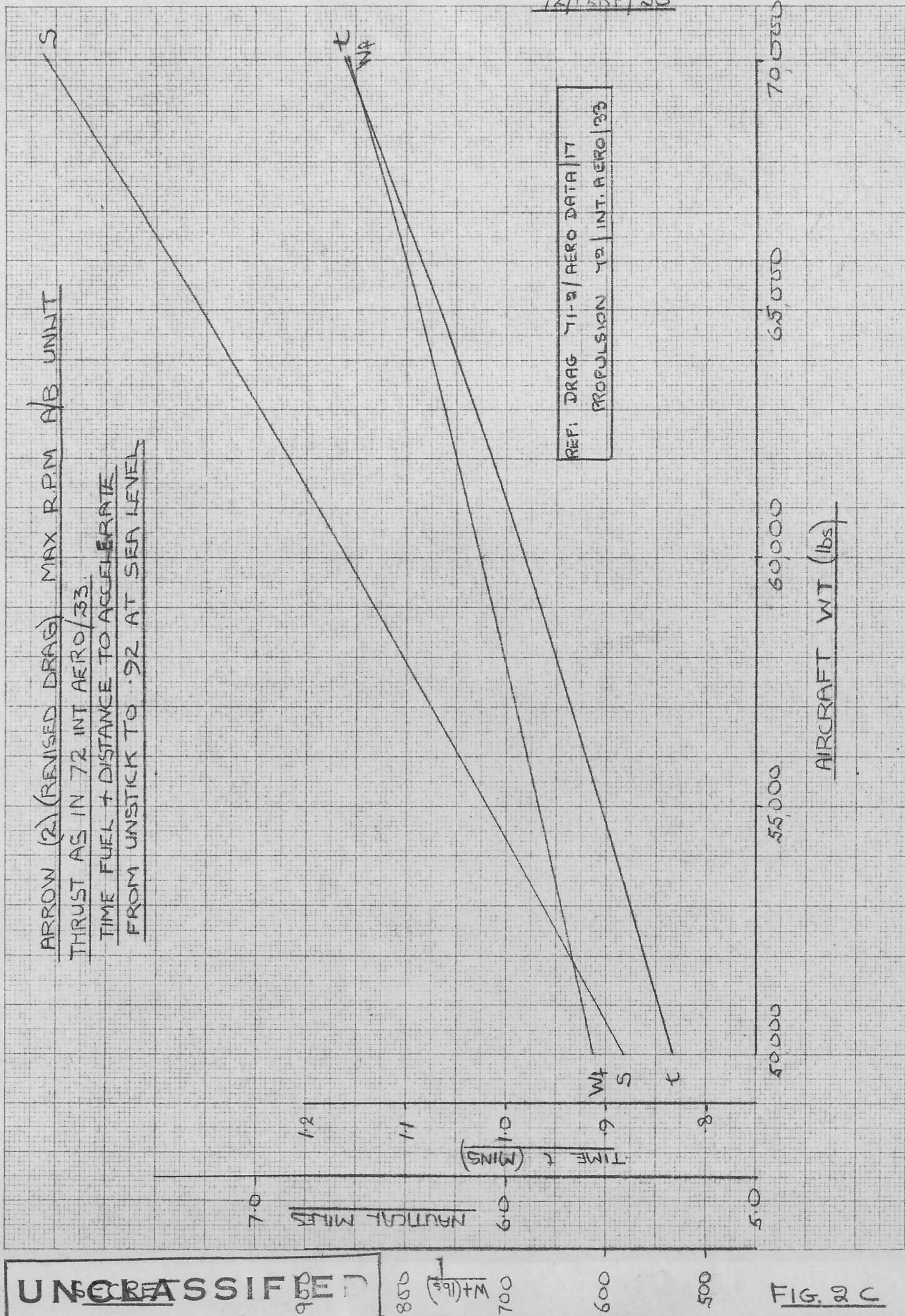
-9-

72/PERF/36

ARROW (2) (REVISED DRAG) MAX R.P.M. A/B UNIT

THRUST AS IN 72 INT AERO/33.

TIME FUEL + DISTANCE TO ACCELERATE
FROM UNSTICK TO .92 AT SEA LEVEL



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FIG. 2 C

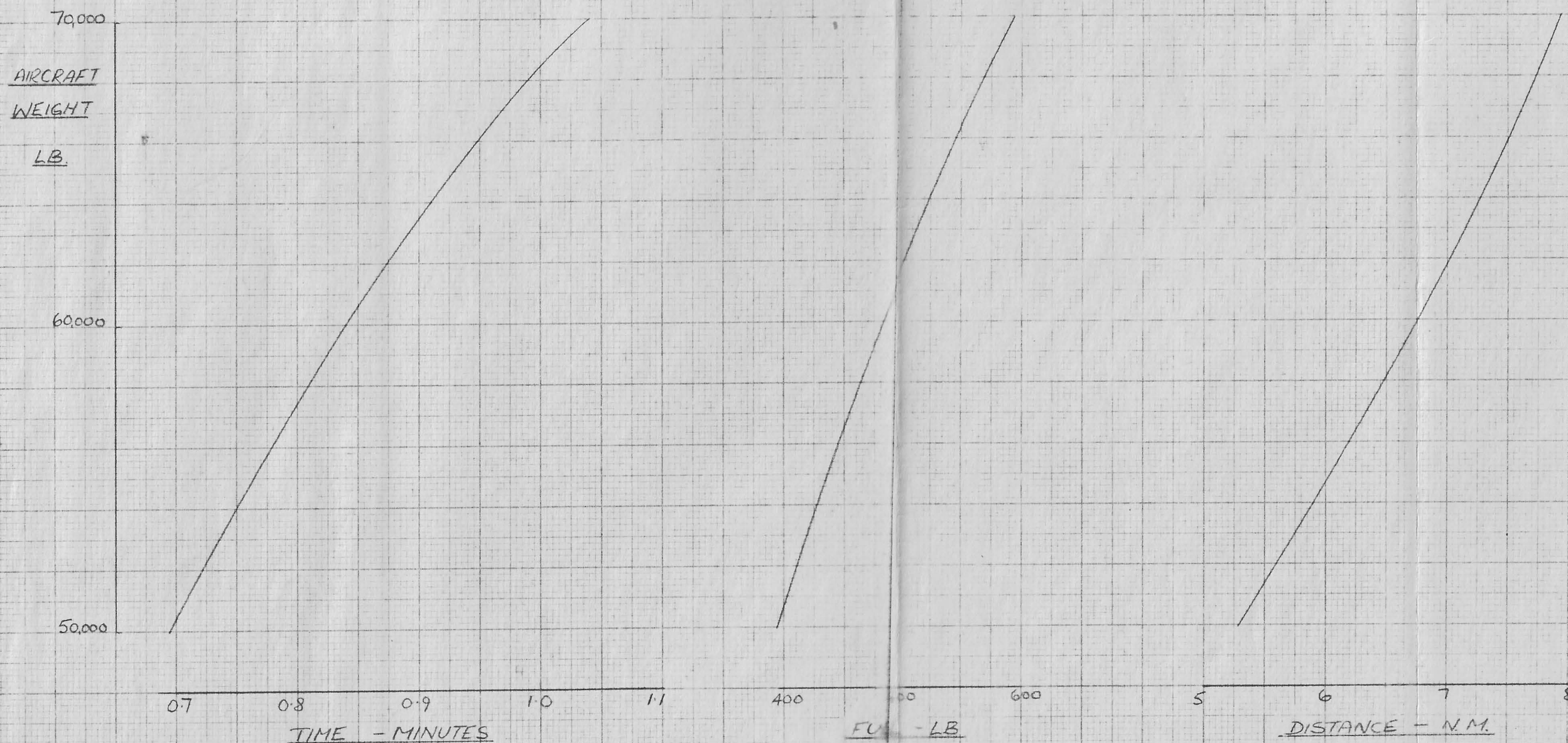
ARROW 2 WITH IRQUOIS SERIES 2 ENGINES

ACCELERATION AT 10,000 FT. 0.5 M TO 0.92 M A/B UNLIT

REF:

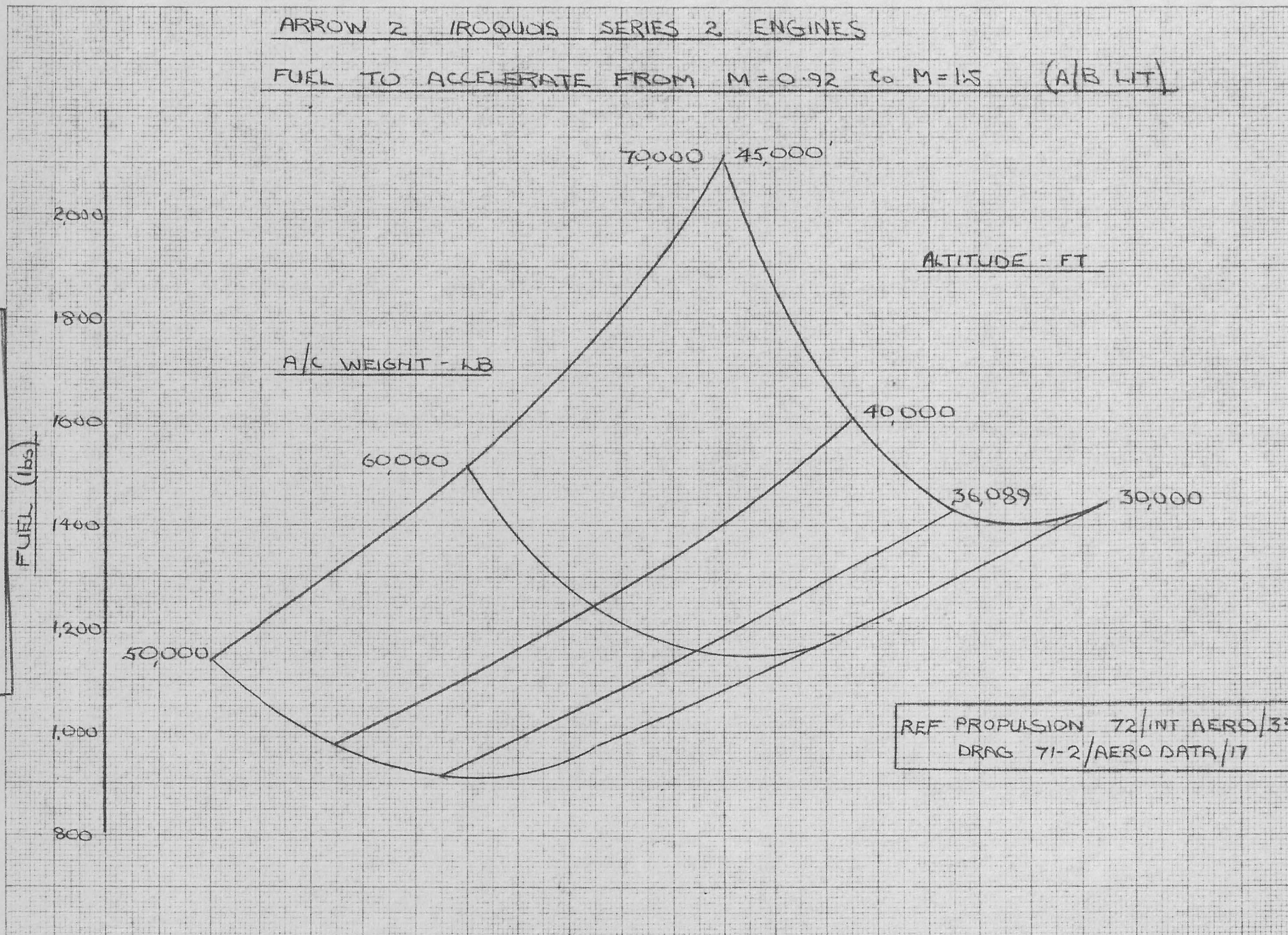
DRAW: 71-2/AERO DATA/17

THRUST: 72/INT AERO/33



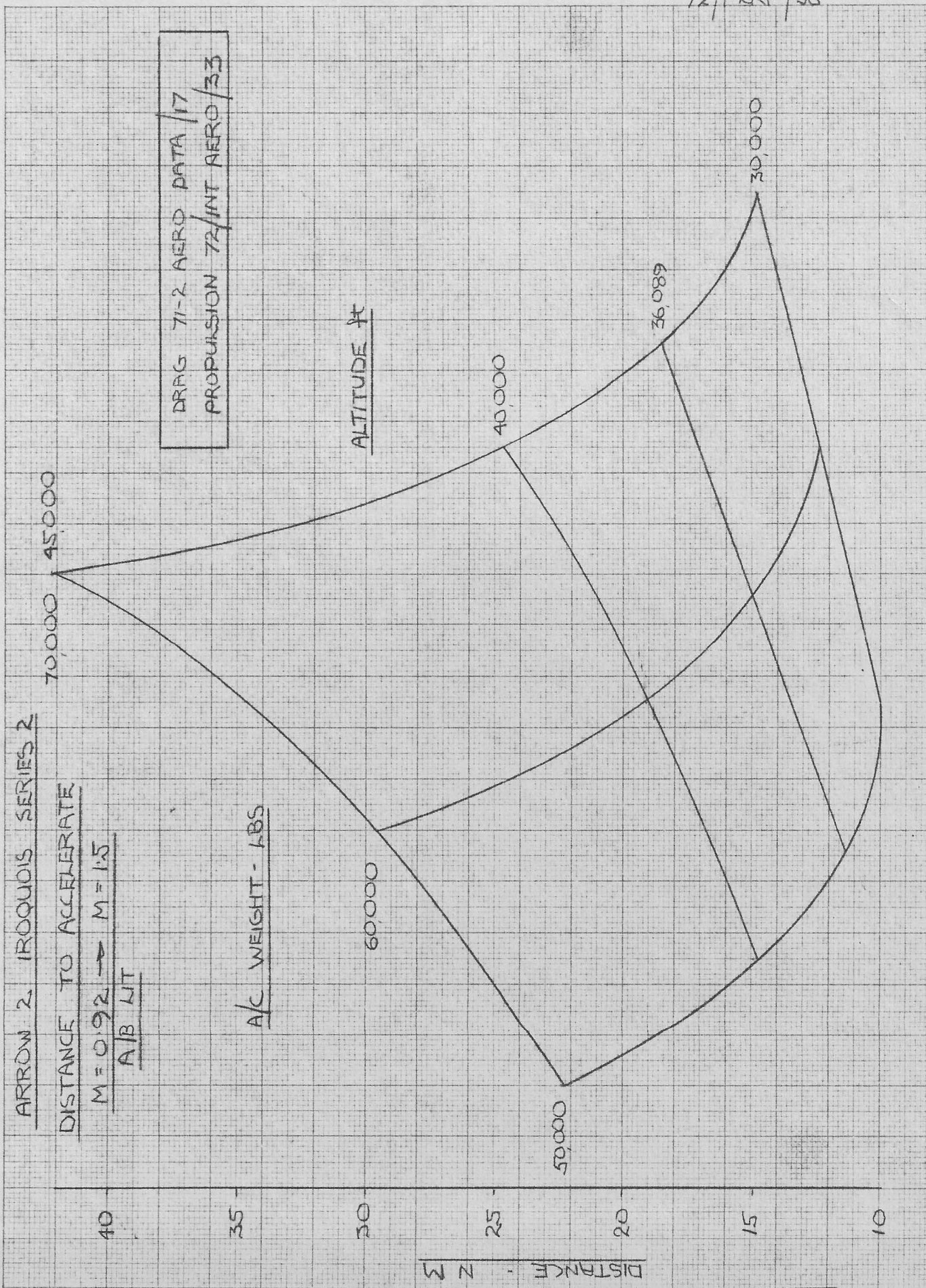
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FIG. 4A



-11-

72/PERF/36



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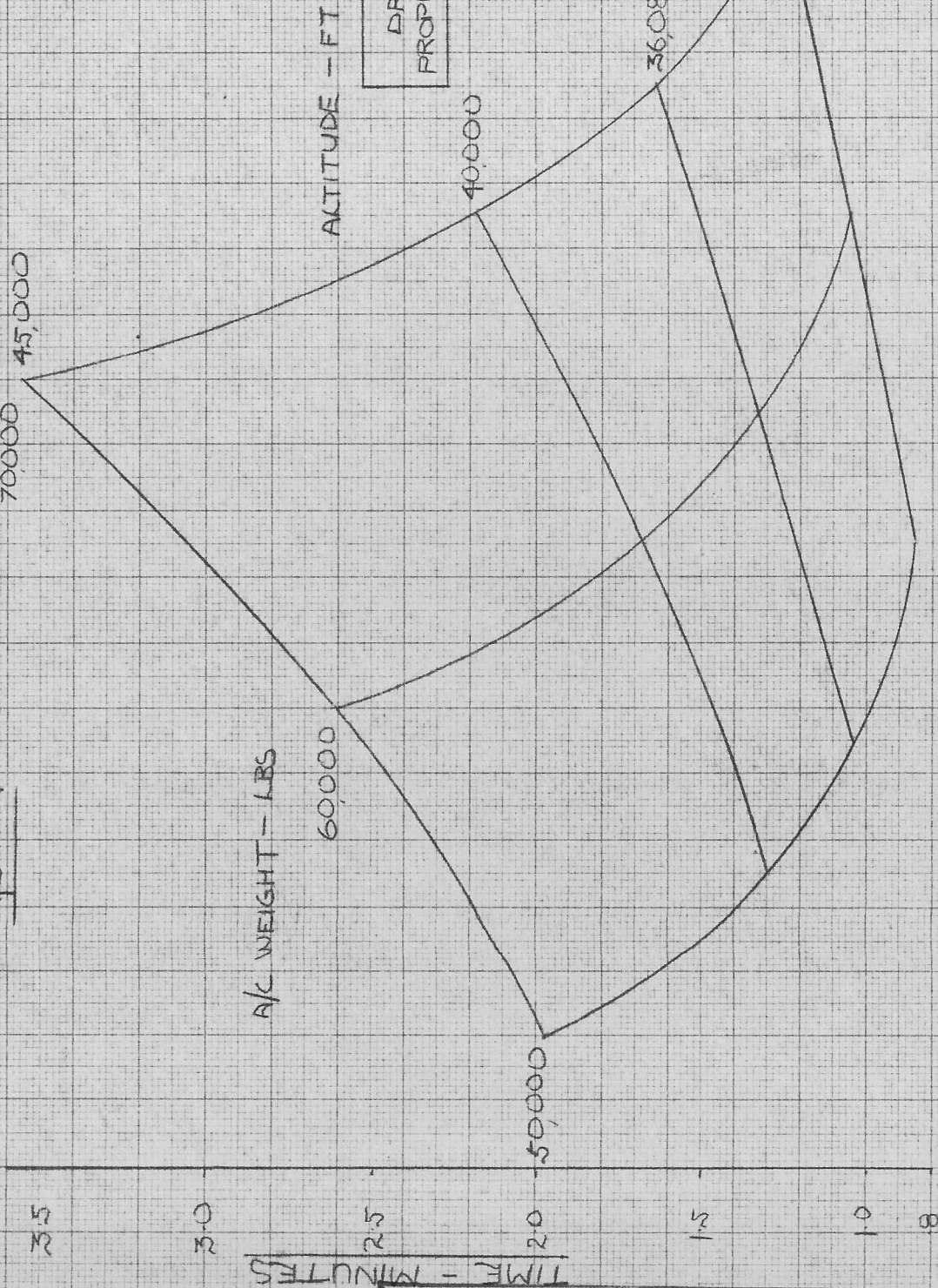
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FIG. 4 B

ARROW 2. IRDQUOIS SERIES 2

TIME TO ACCELERATE FROM 0.92 - 1.5

A/B LIT

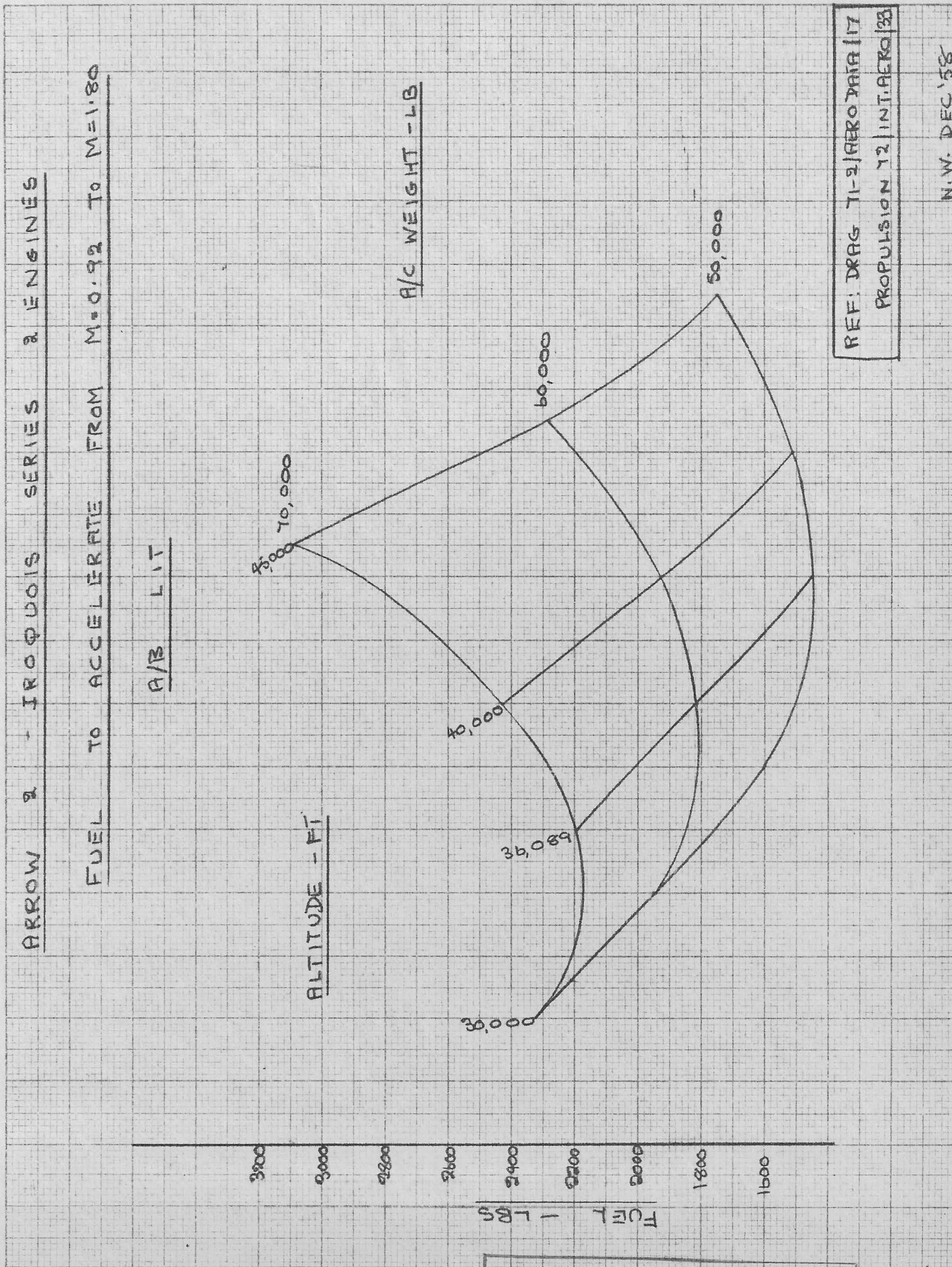


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FIG. 4C

N.W. DEC '58



ARROW 2 - IROQUOIS SERIES 2 ENGINES

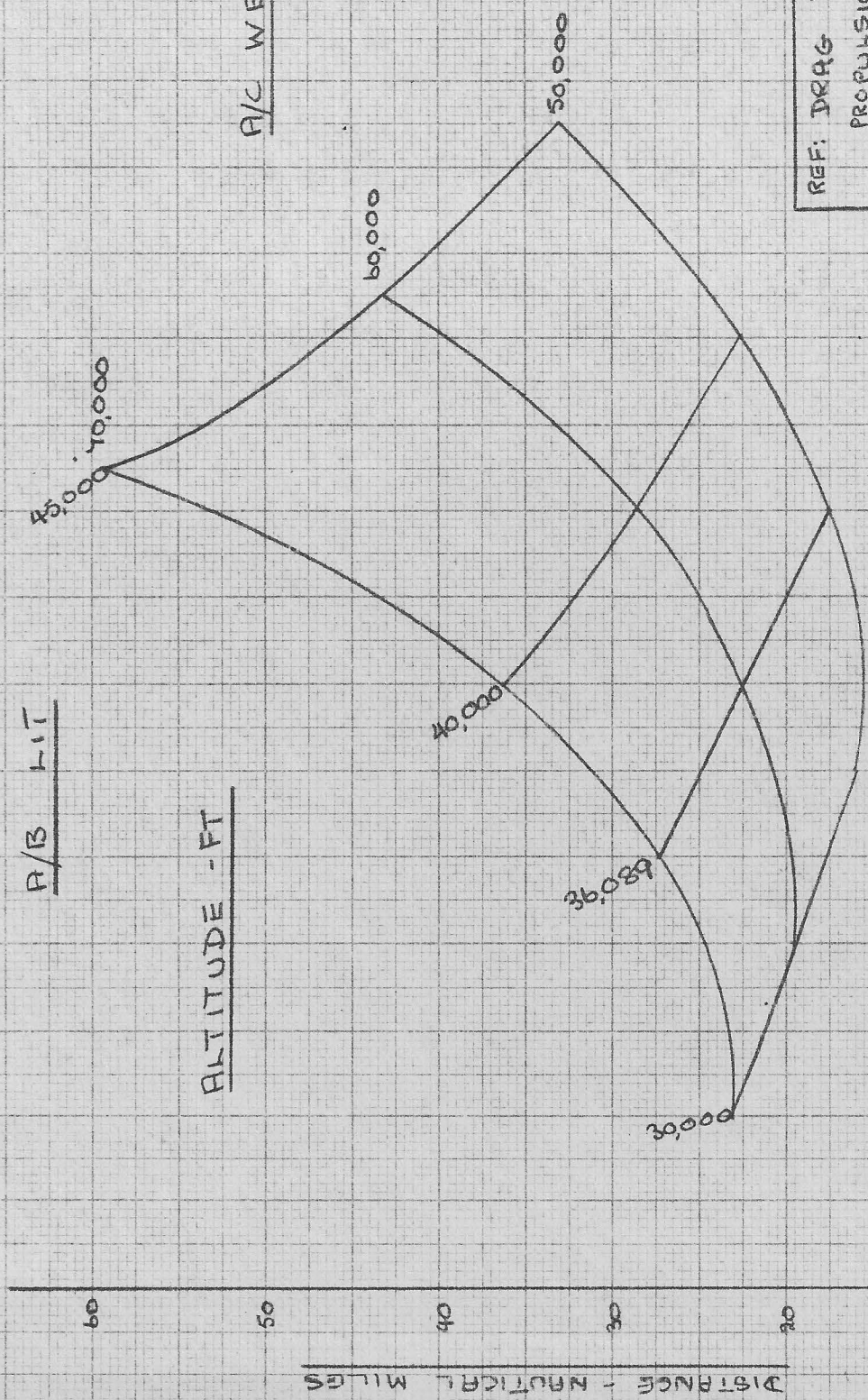
DISTANCE TO ACCELERATE FROM M=0.92 TO M=1.80

A/B LIT

ALTITUDE - FT

A/C WEIGHT - LB

REF: DRAG 41-2 | AERODATA | 17
PROPULSION 72/INT. AERO | 33



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FIG. 5B

ARROW 2 - IROQUOIS SERIES 2 ENGINES

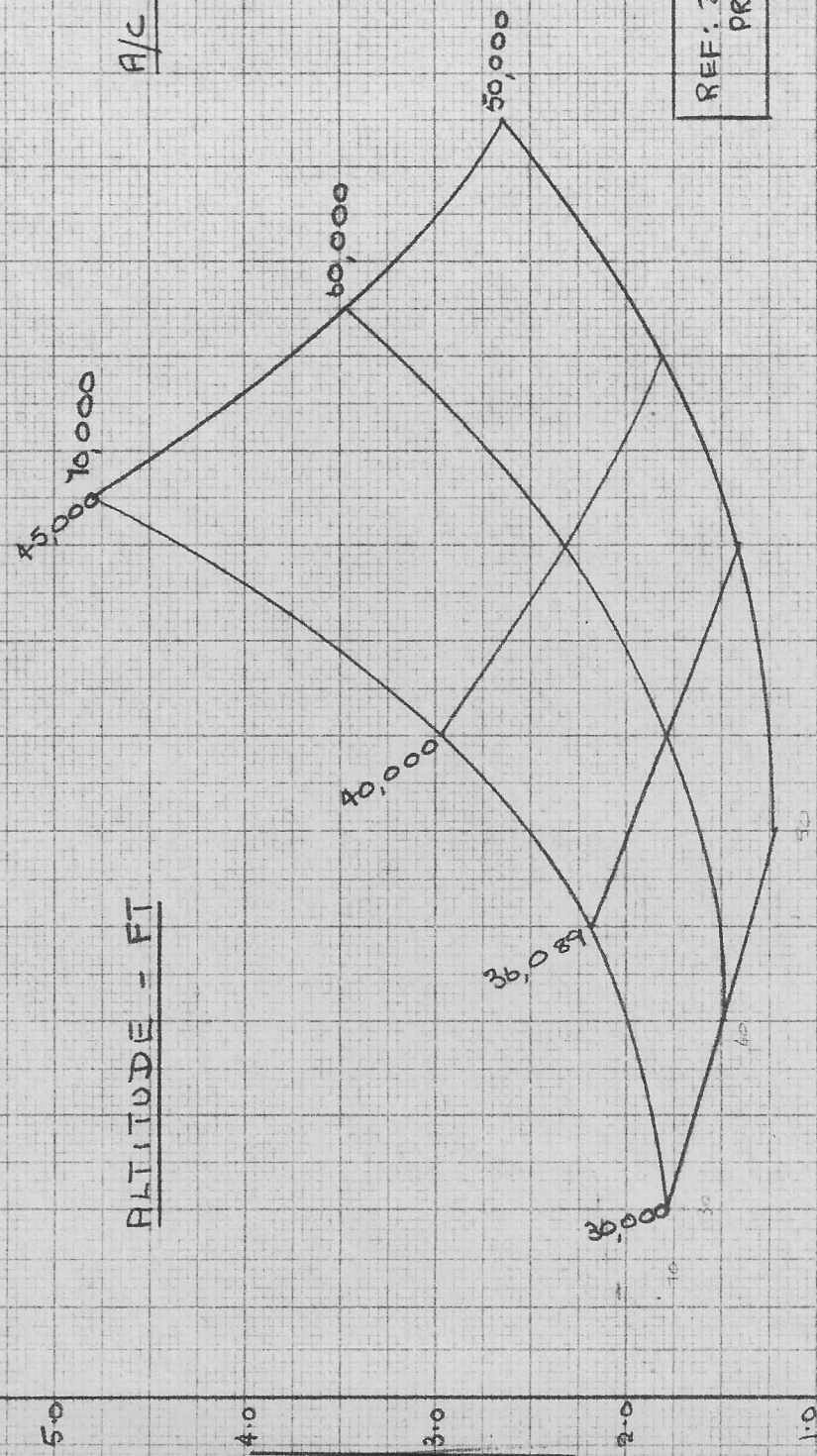
TIME TO ACCELERATE FROM M=0.92 TO M=1.80

A/B LIT

ALTITUDE - FT

A/C WEIGHT - LB

REF: DRAG T1-2/PERODATA/17
PROPULSION T2/INI. PERD/33



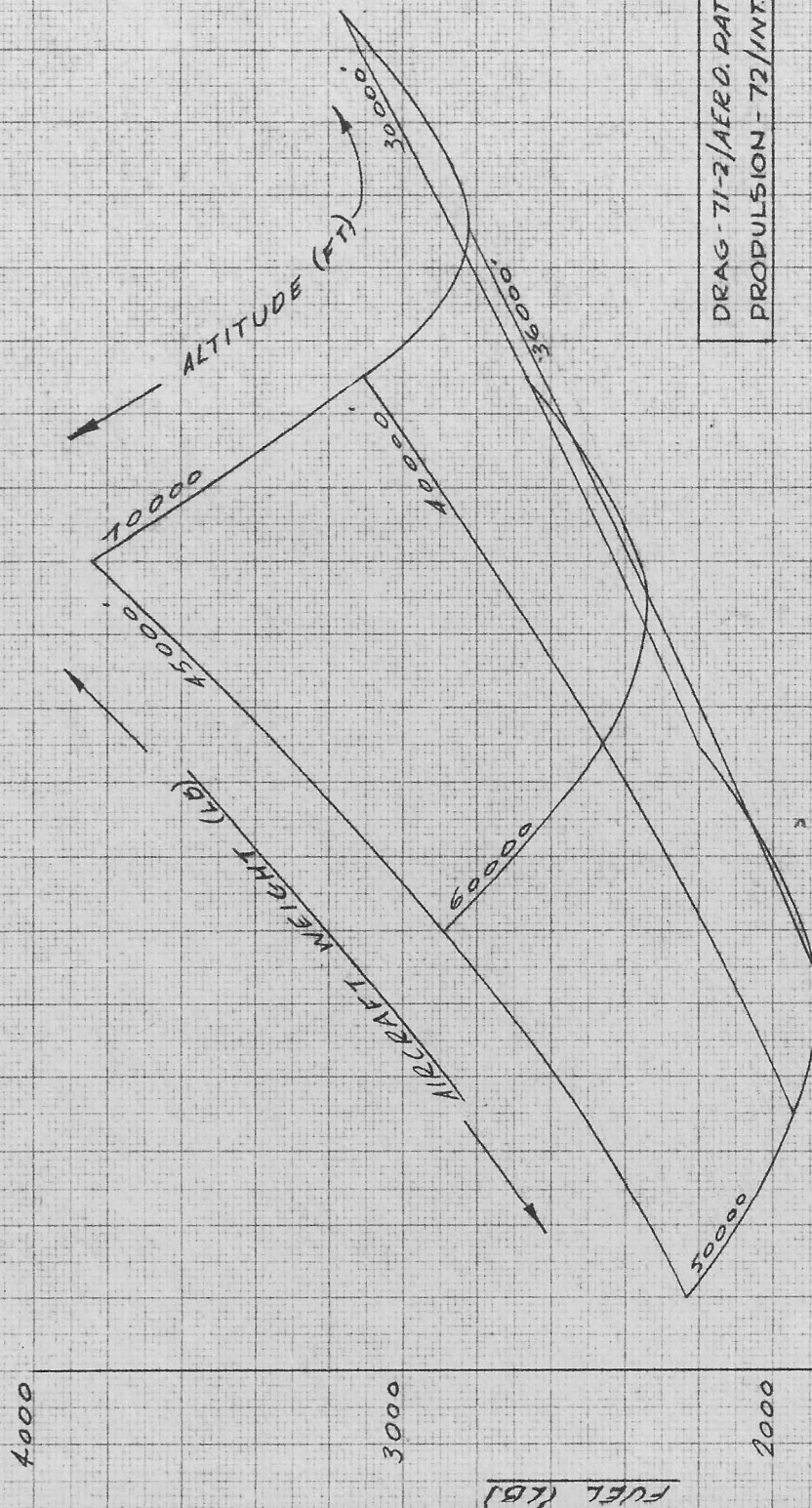
SECRET UNCLASSIFIED

FIG. 5C

ARROW 2

FUEL TO ACCELERATE FROM $M=0.92$ TO $M=2.0$

IROQUOIS SERIES 2 AFTERBURNER LIT

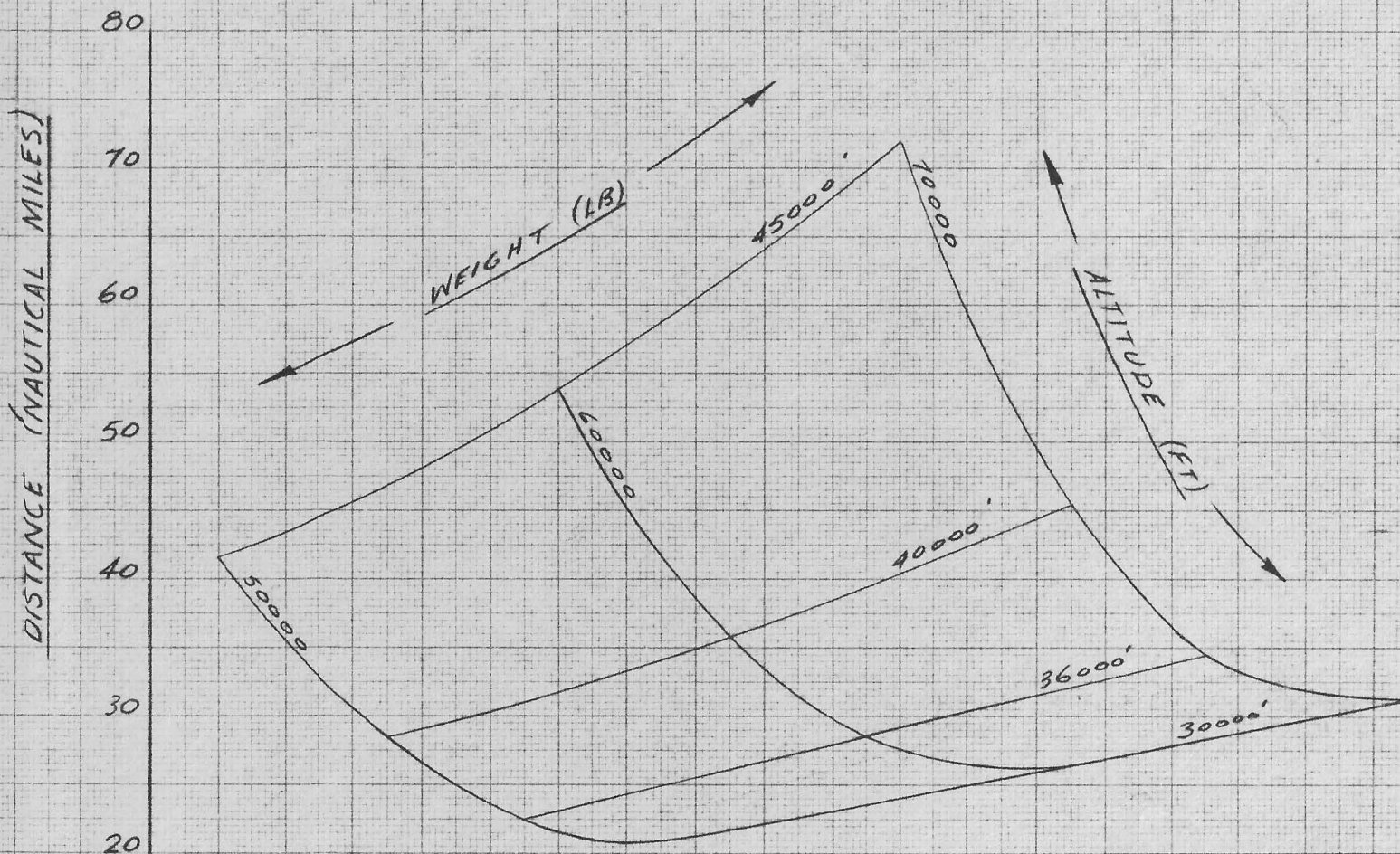


DRAG-71-2/AERO. DATA/17
PROPULSION-72/INT. AERO/33

ARROW 2

DISTANCE TO ACCELERATE FROM $M=0.92$ TO $M=2.0$

IROQUOIS SERIES 2 AFTERBURNER LIT



DRAG - 71-2/AERO DATA/17
PROPULSION - 72/INT. AERO/33

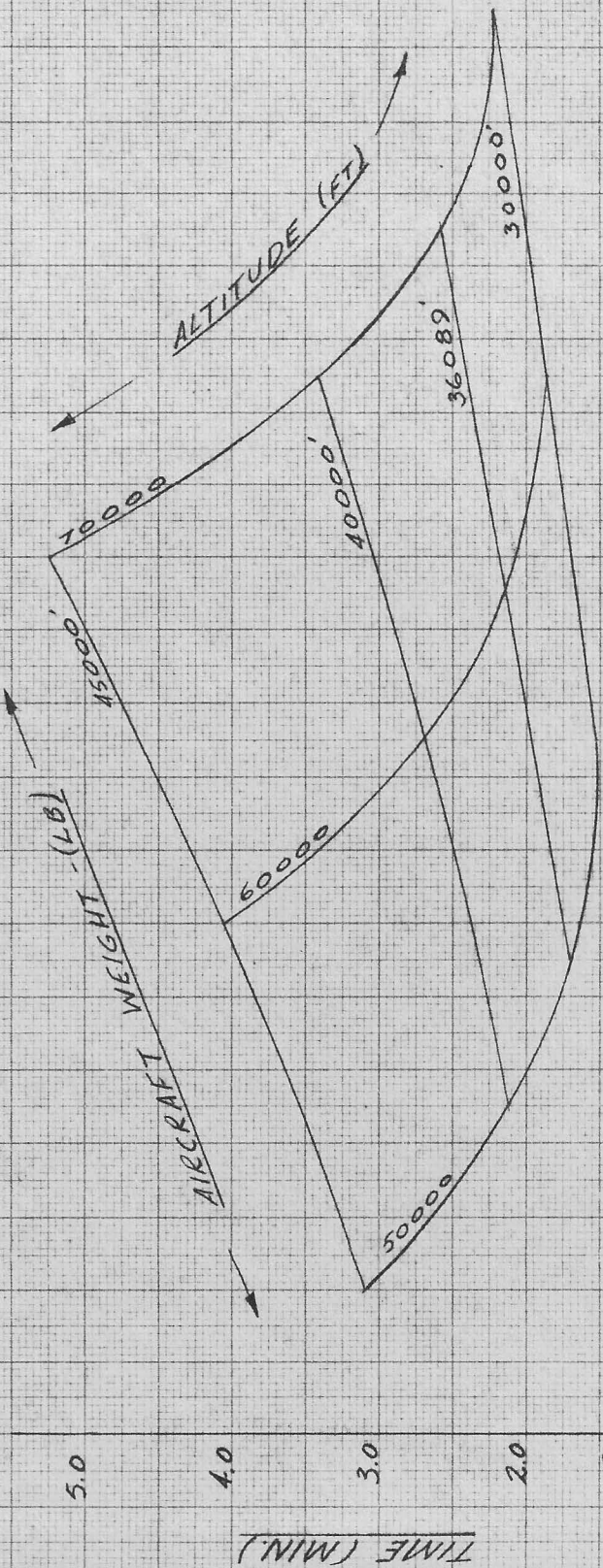
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FIG. 6B

ARROW 2

TIME TO ACCELERATE FROM $M=0.92$ TO $M=2.0$

IROQUOIS SERIES 2 AFTERBURNER LIT



DRAG - 71-2/AERO DATA/17
PROPULSION - 72/INT. AERO/33

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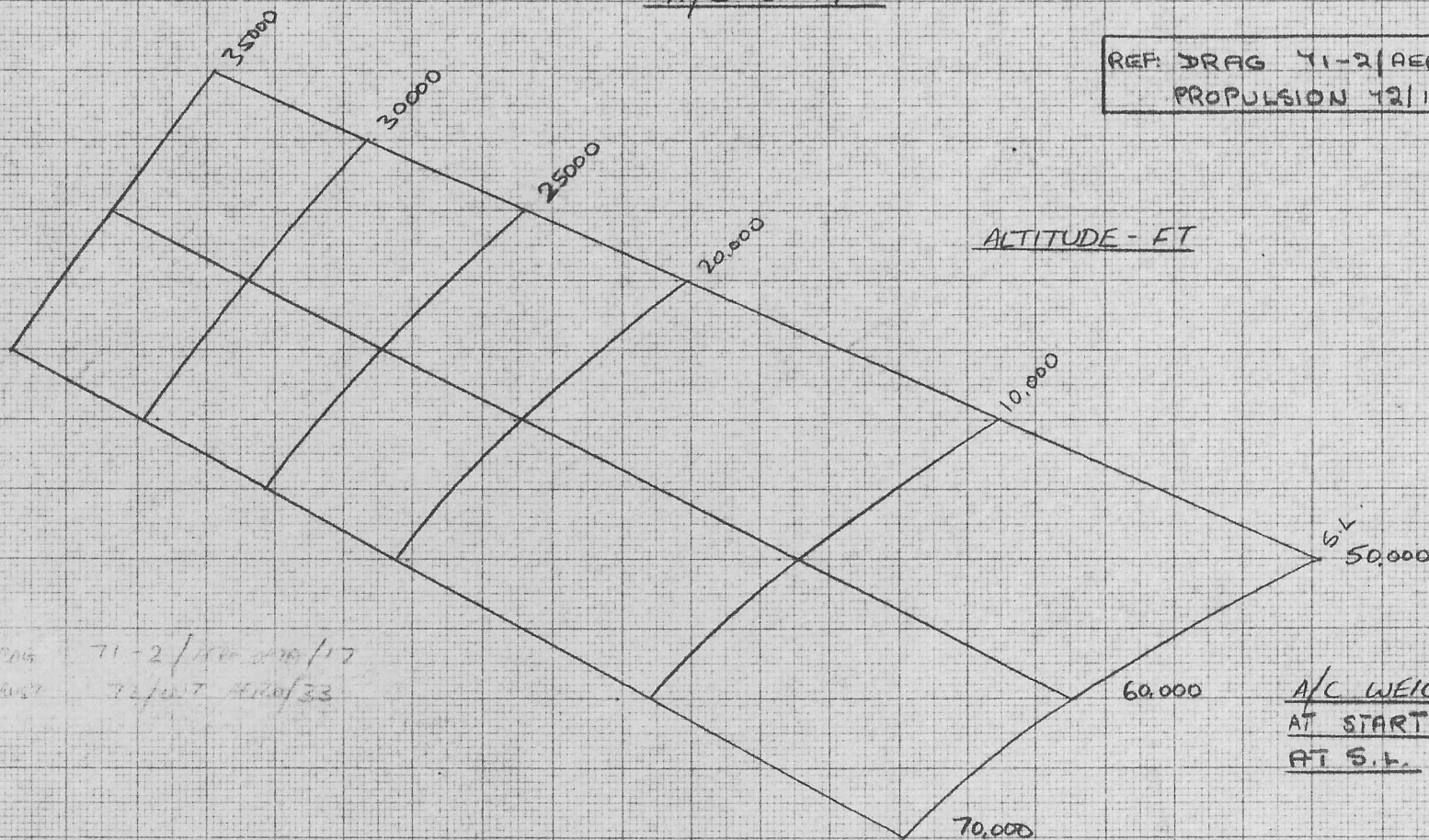
FIG. 6c

ARROW 2 IROQUOIS SERIES 2 ENGINES

RATE OF CLIMB AT CONSTANT 527 KNOTS TAS

A/B UNLIT

REF. DRAG 71-2/AERO DATA/17
PROPULSION 72/INT. AERO/33



REF. DRAG 71-2/AERO DATA/17
PROPULSION 72/INT. AERO/33

A/C WEIGHT LB
AT START OF CLIMB
AT S.L.

RATE OF CLIMB - FT/MIN $\times 10^{-3}$

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FIG. 7A

-90-

72/PERF/36

ARROW 2 - CLIMB

FUEL TO HEIGHT @ 527 Kts TAS - STANDARD DAY

IROQUOIS SERIES 2 AFTERBURNER UNLIT

A/C WEIGHT
AT START (LB)

50 000

55 000

60 000

65 000

70 000

SEA LEVEL

500

1000

1500

2000

FUEL USED (LB)

ALTITUDE

DRAG - 11-2/AERO.DATA/V7
PROPULSION - 12/INT.AERO/33

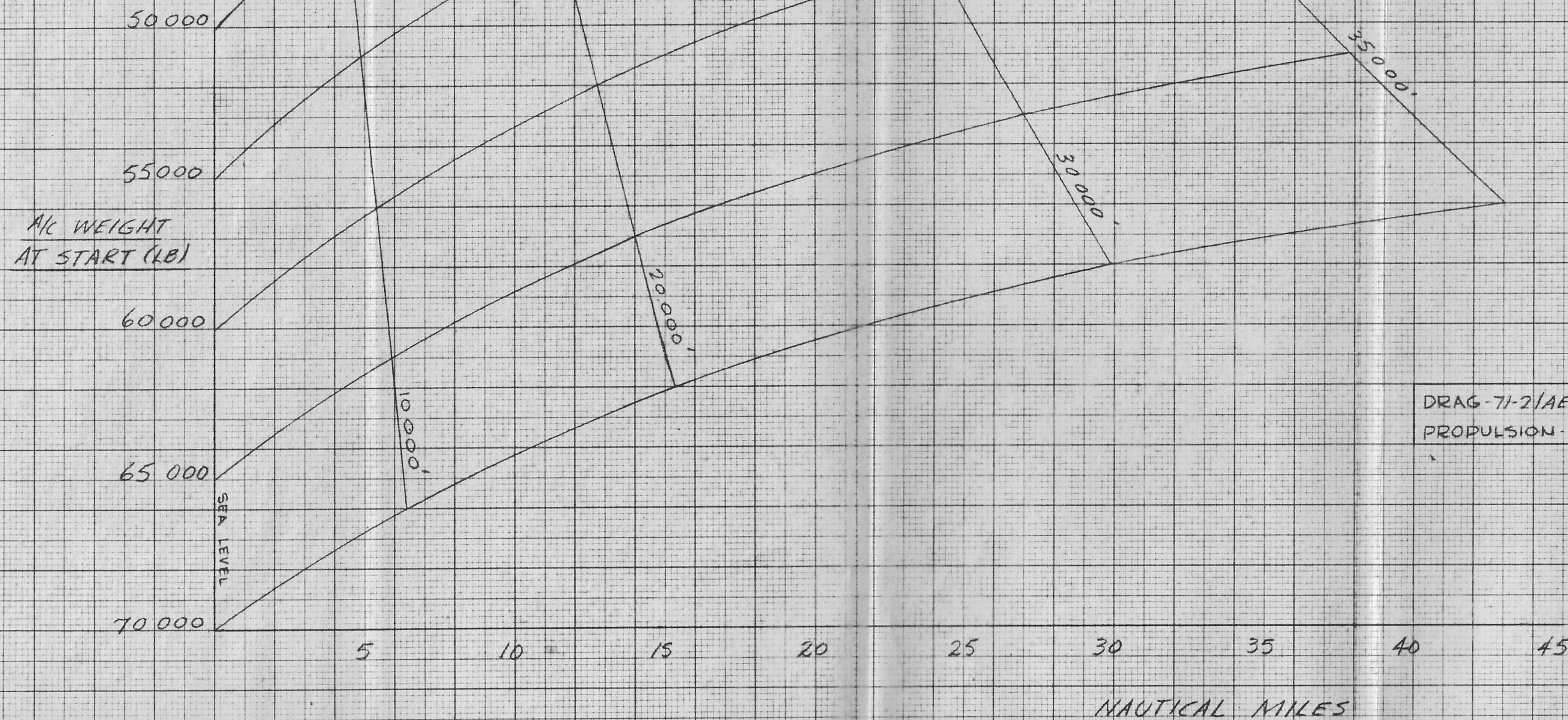
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FIG. 7 B

ARROW 2 - CLIMB

DISTANCE TO HEIGHT @ 527 KTS - STANDARD DAY

IROQUOIS SERIES 2 AFTERBURNER UNLIT



DRAG - 71-2/AERO DATA/17
 PROPULSION - 72/INT. AERO/33

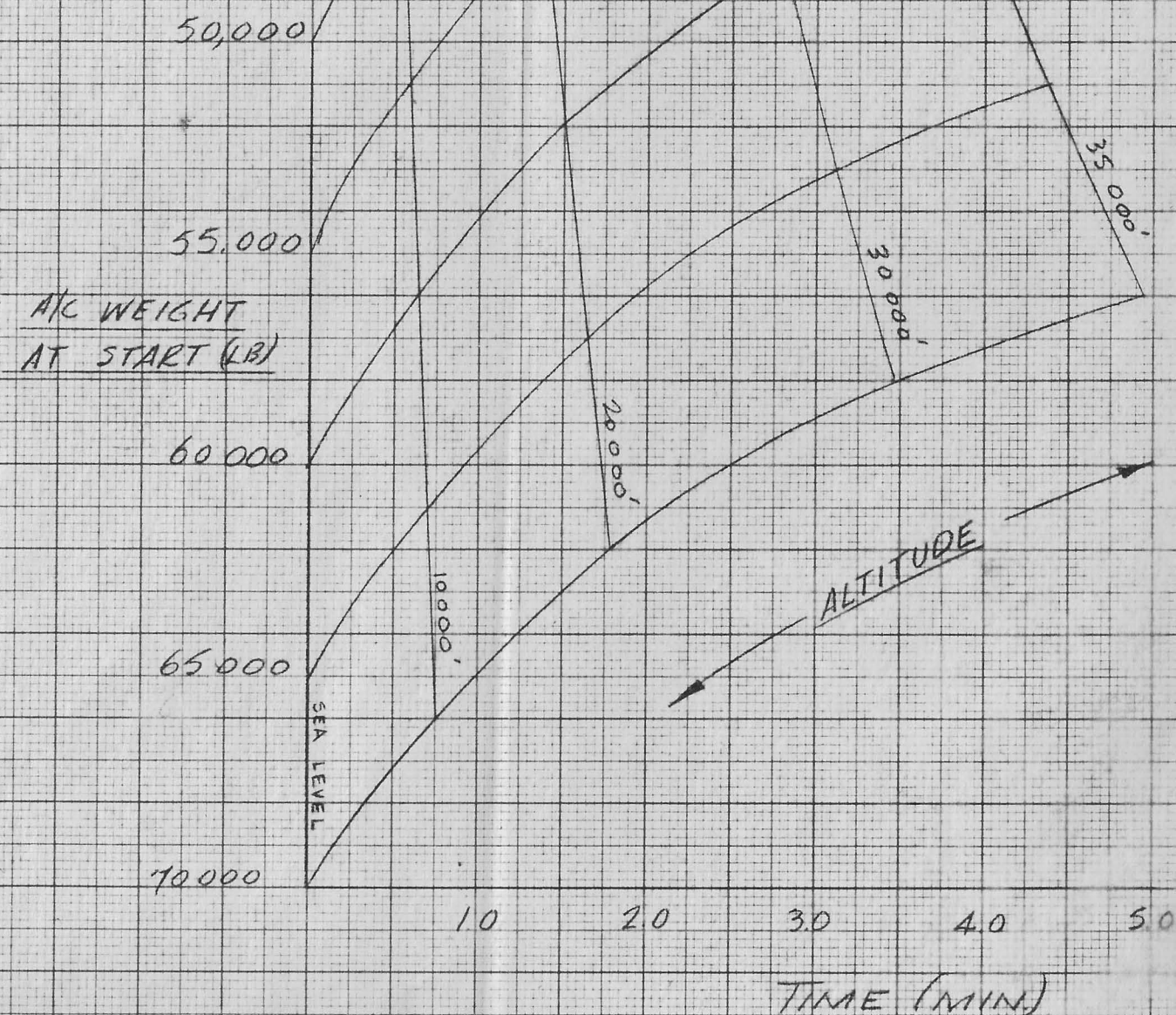
UNCLASSIFIED

FIG. 7C

ARROW 2 - CLIMB

TIME TO HEIGHT @ 527 KTS TAS. - STANDARD DAY

IROQUOIS SERIES 2 AFTERBURNER UNLIT

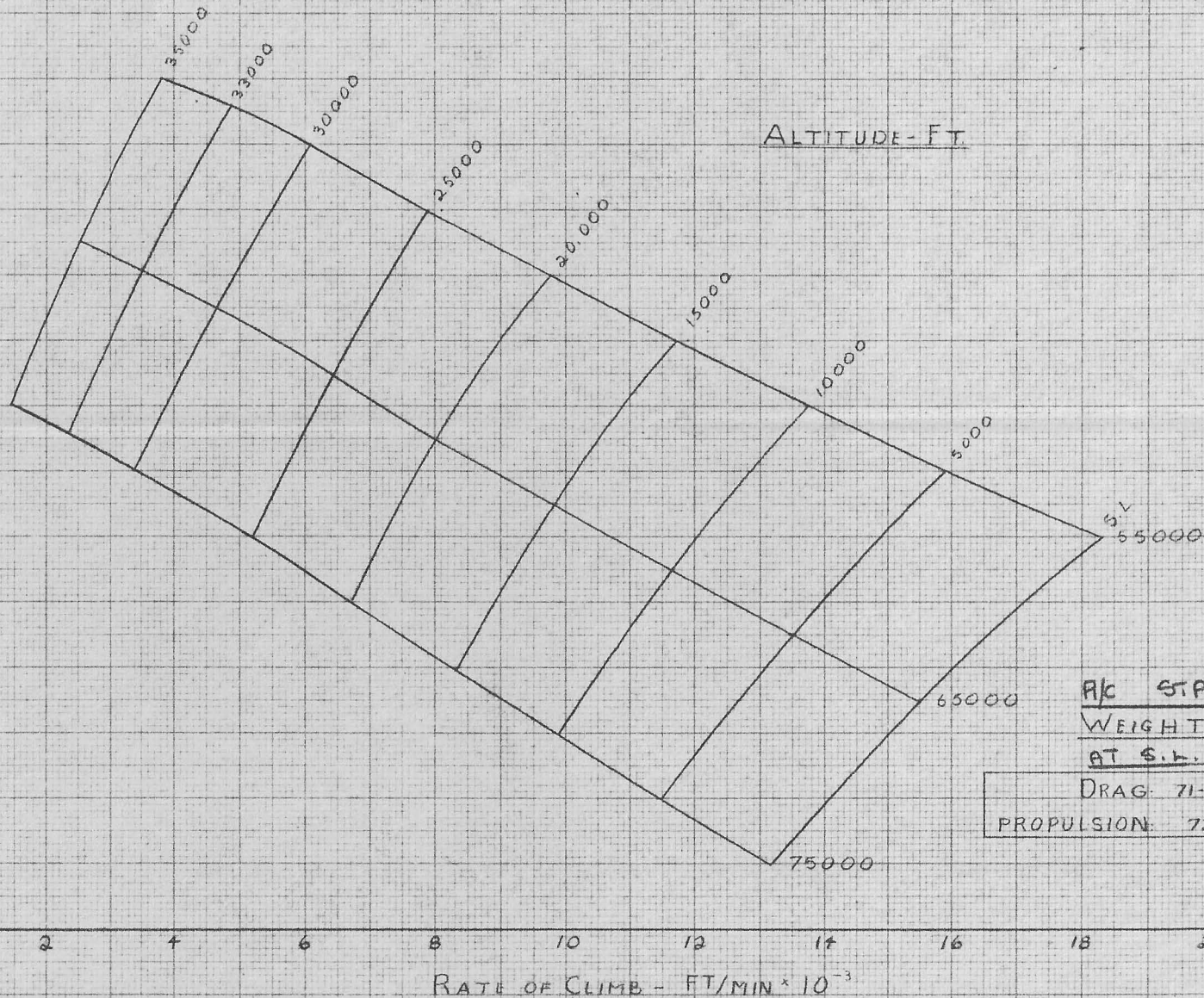


DRAG - 712/AERO DATA/17
PROPULSION - 72/INT. AERO/33

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FIG 7D

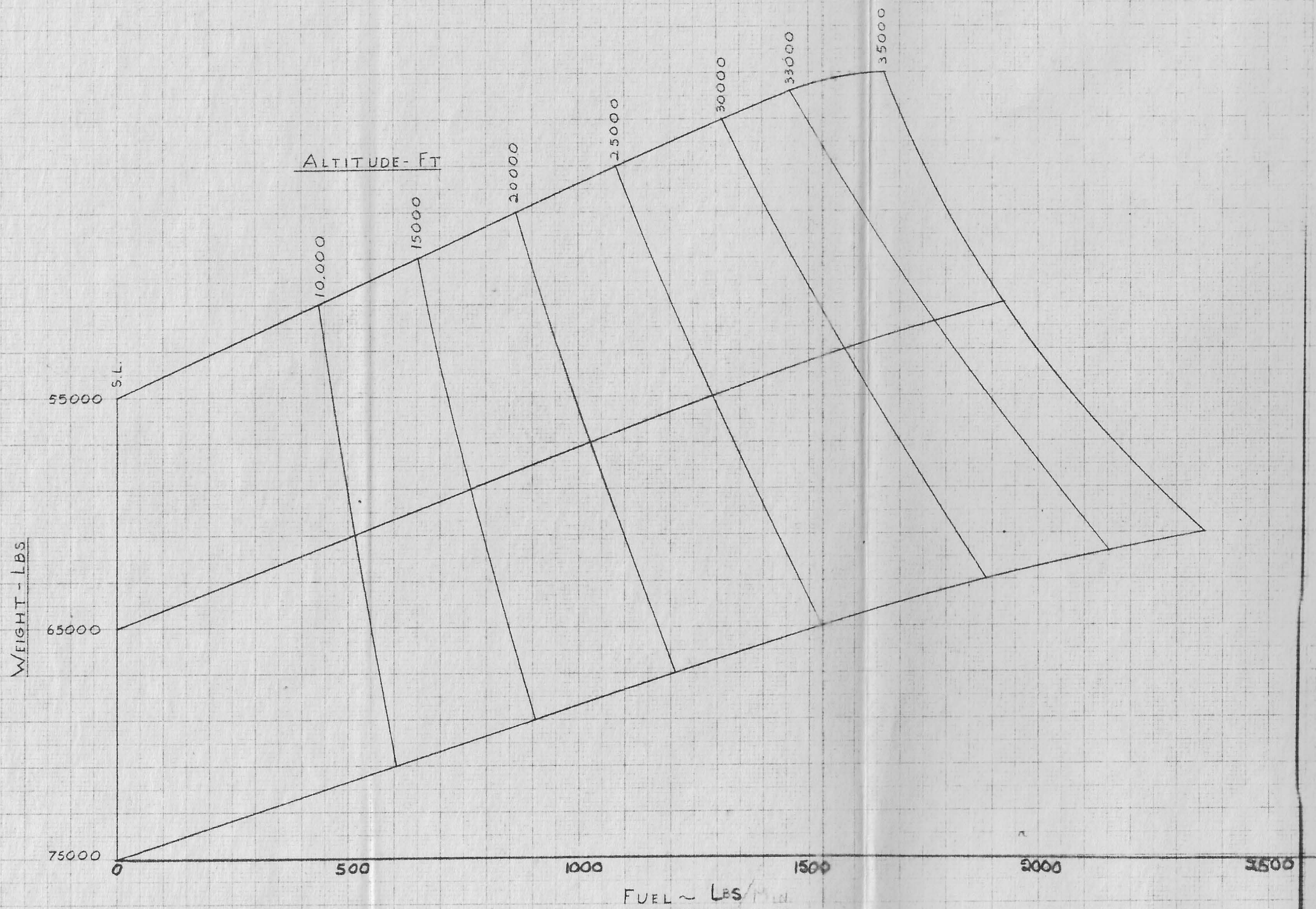
ARROW 2 IROQUOIS SERIES 2 A/B UNLIT
RATE OF CLIMB @ 527 KNOTS WITH VENTRAL TANK.



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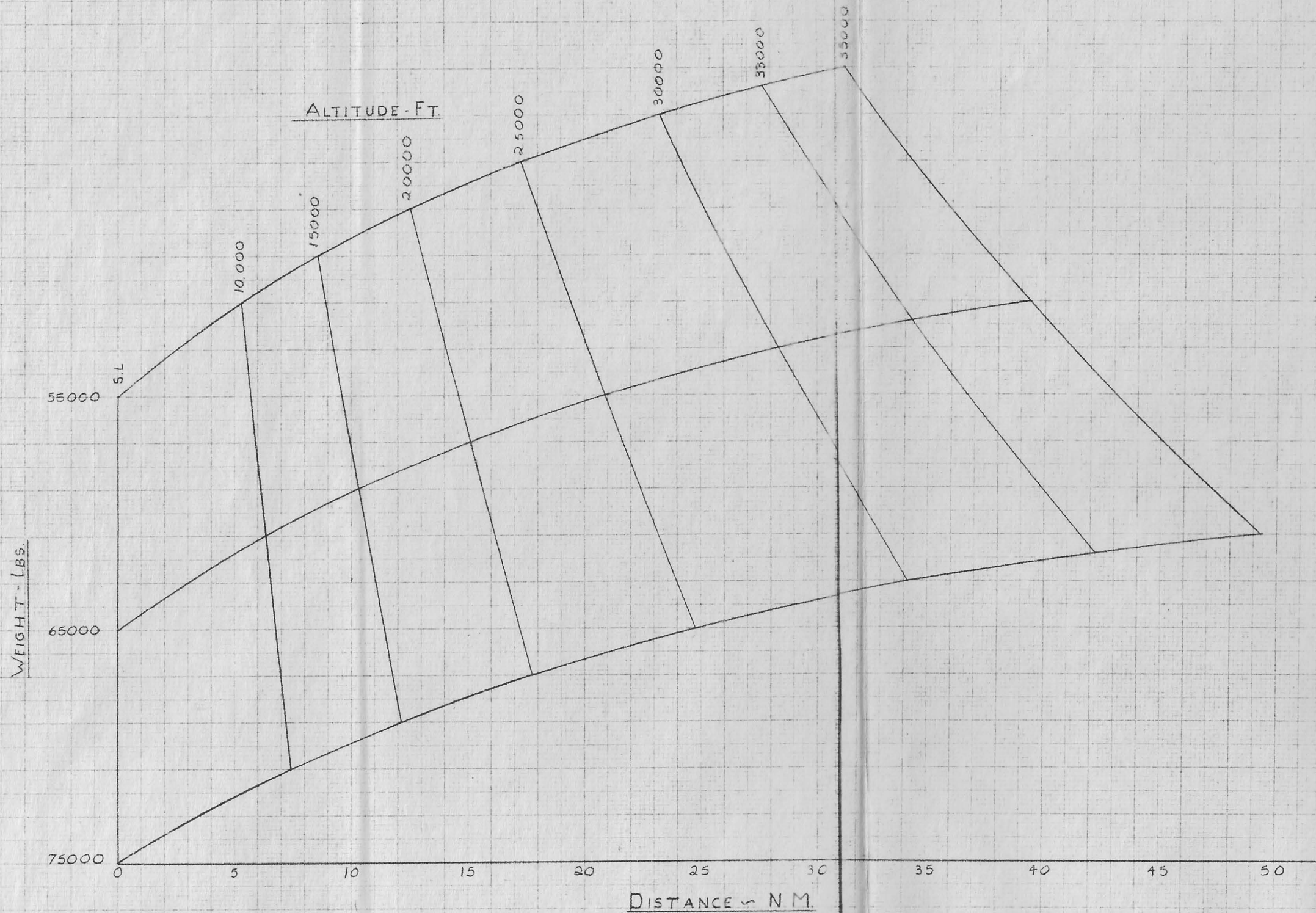
FIG 8A

ARROW 2 IROQUOIS SERIES 2
FUEL TO HEIGHT @ 527 KTS A/B UNLIT WITH VENTRAL TANK



PROPULSION: 72/INT. AERO/33
DRAG: 71-2/AERO DATA/17

ARROW 2 IRON HORSE SERIES 2
DISTANCE TO HEIGHT @ 527 KTS A/B UNLIT WITH VENTRAL TANK

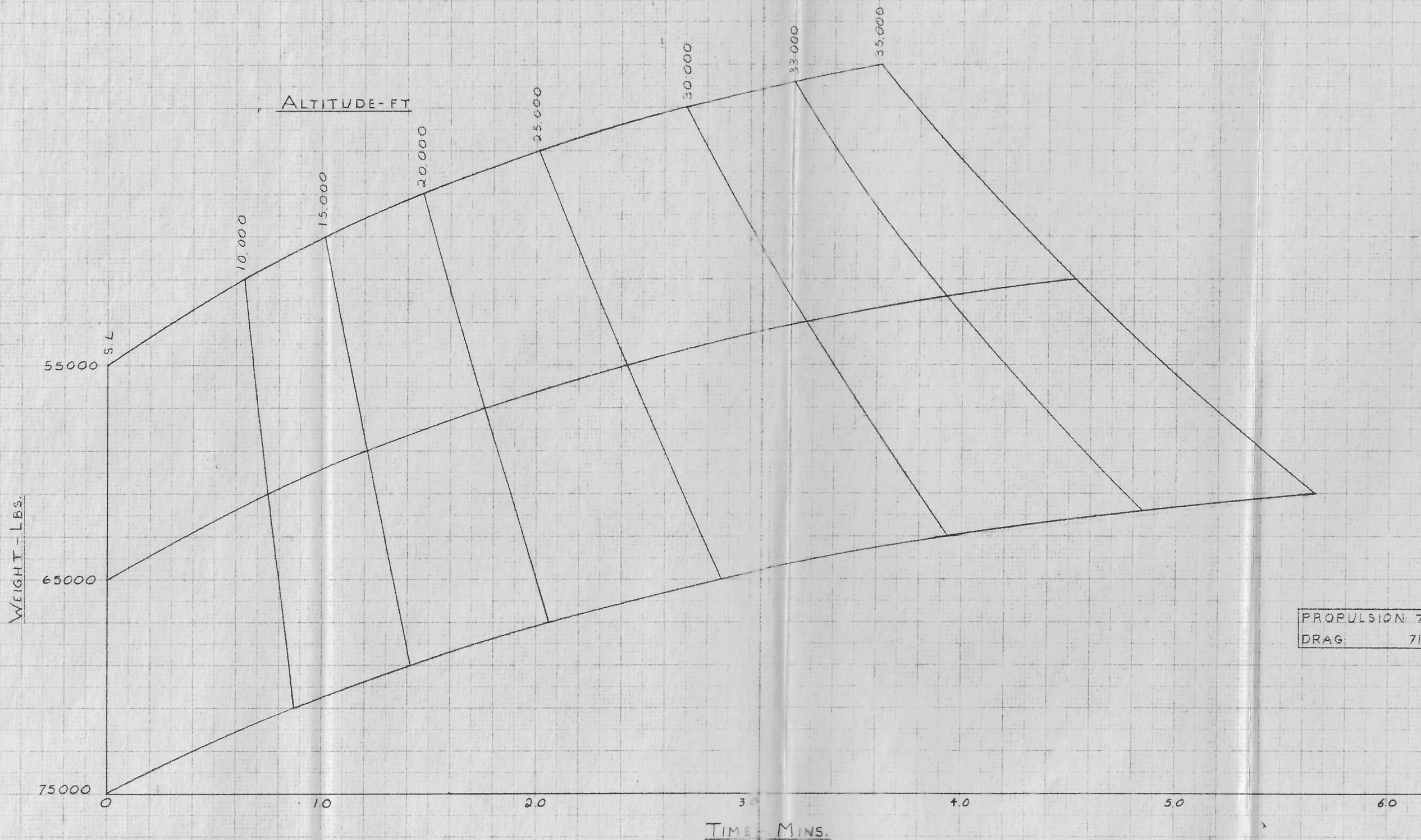


PROPULSION: 72/INT. AERO/33
DRAG: 71-2/AERO DATA/17

Report No. 72/PERF/36

ARROW 2 IROQUOIS SERIES 2

TIME TO HEIGHT @ 527 KTS A/B UNLIT WITH VENTRAL TANK



PROPULSION: 72/INT. AERO/33
DRAG: 71-2/AERO DATA/17

ARROW 2 IROQUOIS SERIES 2 ENGINE

RATE OF CLIMB AT M.N. = 0.92

A/B LIT

REF: DRAG 41-2/AERO DATA/17
PROPULSION 42/INT. AERO/33

ALTITUDE - FT

4° AILERON ABOVE 45,000'

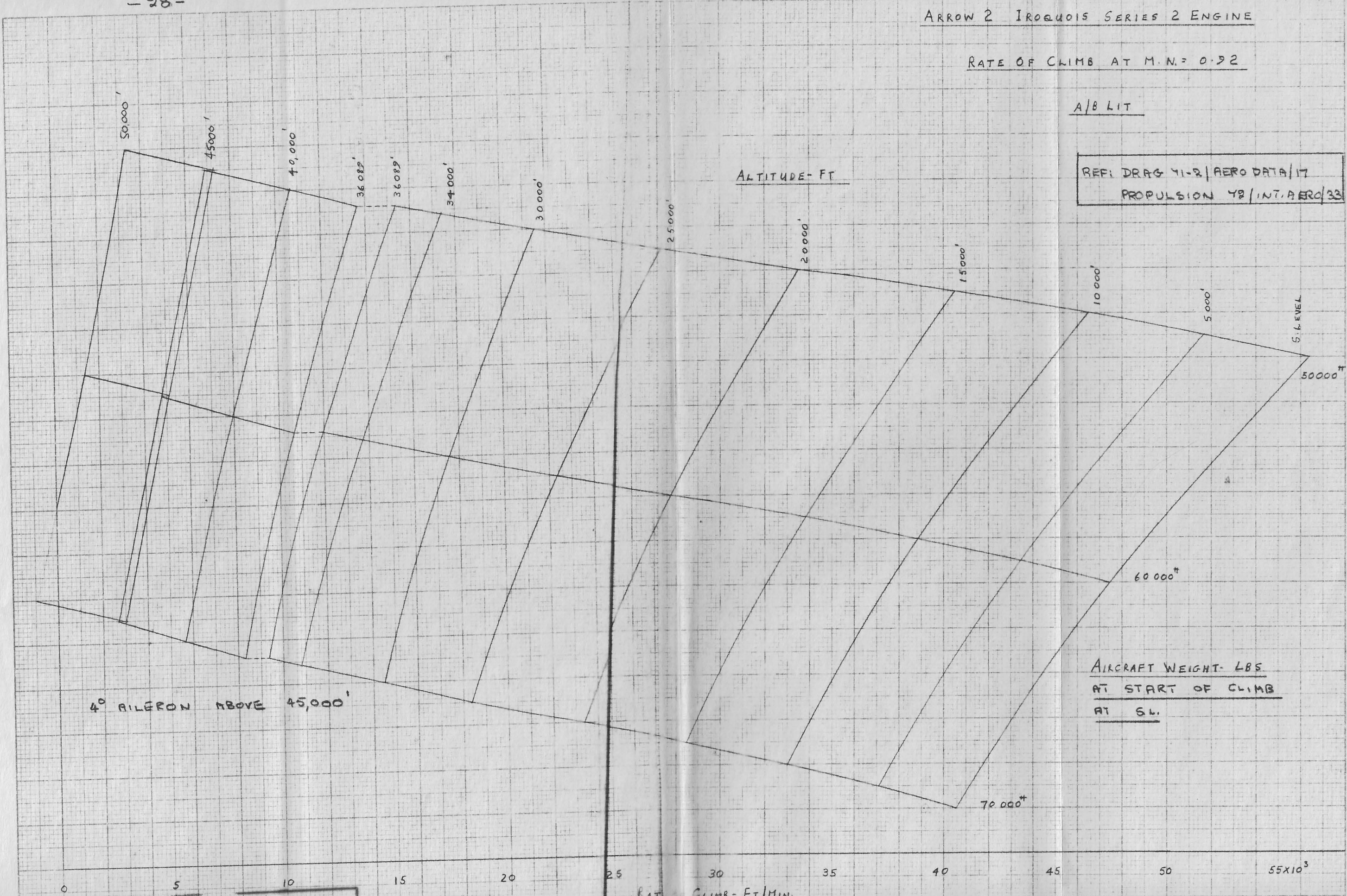
AIRCRAFT WEIGHT - LBS
AT START OF CLIMB
AT SL.

RATE OF CLIMB - FT/MIN.

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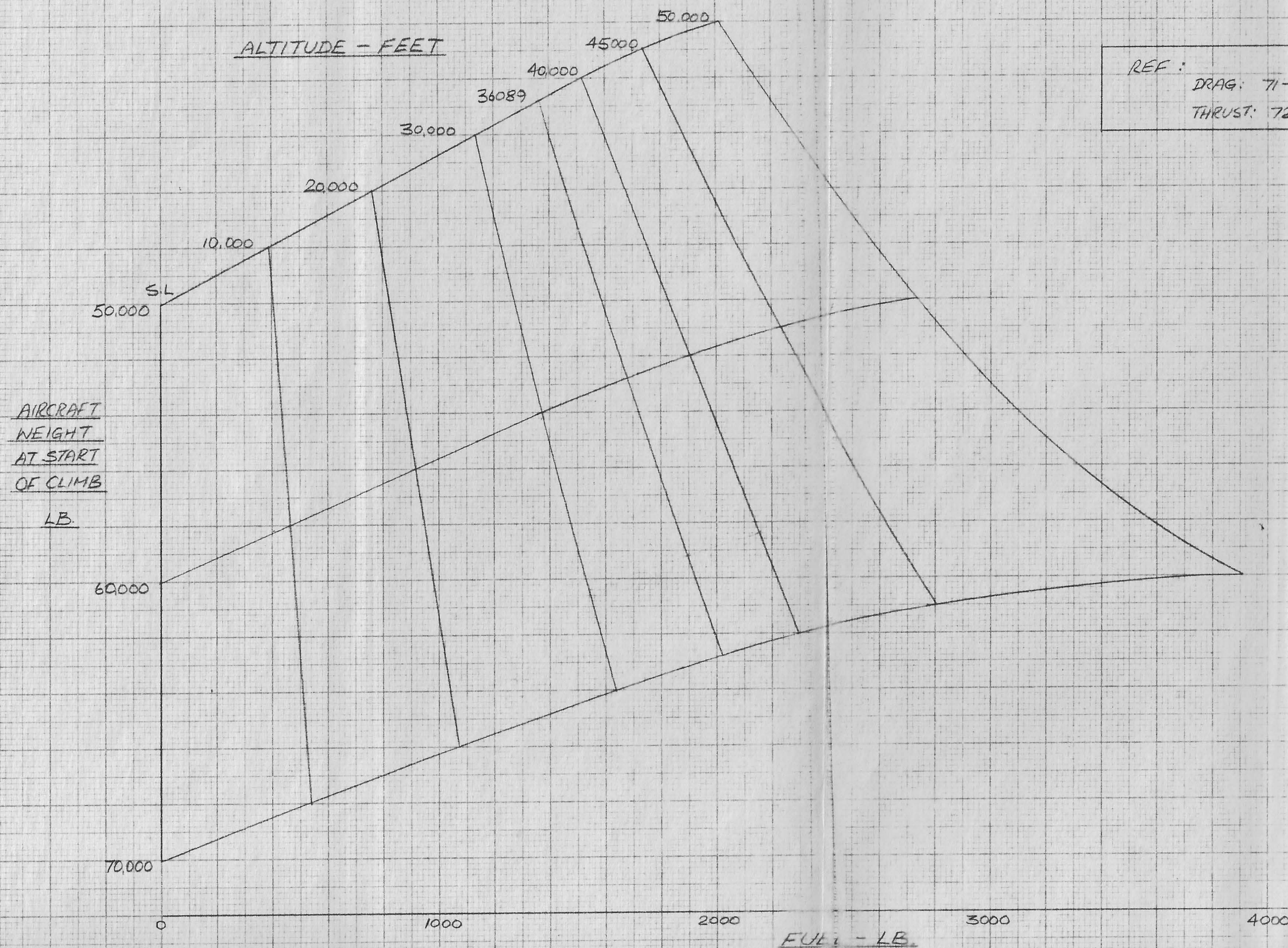
FIG. 9A

KE 10 X 10 TO THE 1/2 INCH
KEUFFEL & ESSER CO.
MADE IN U.S.A.



ARROW 2 WITH IROQUOIS SERIES 2 ENGINES

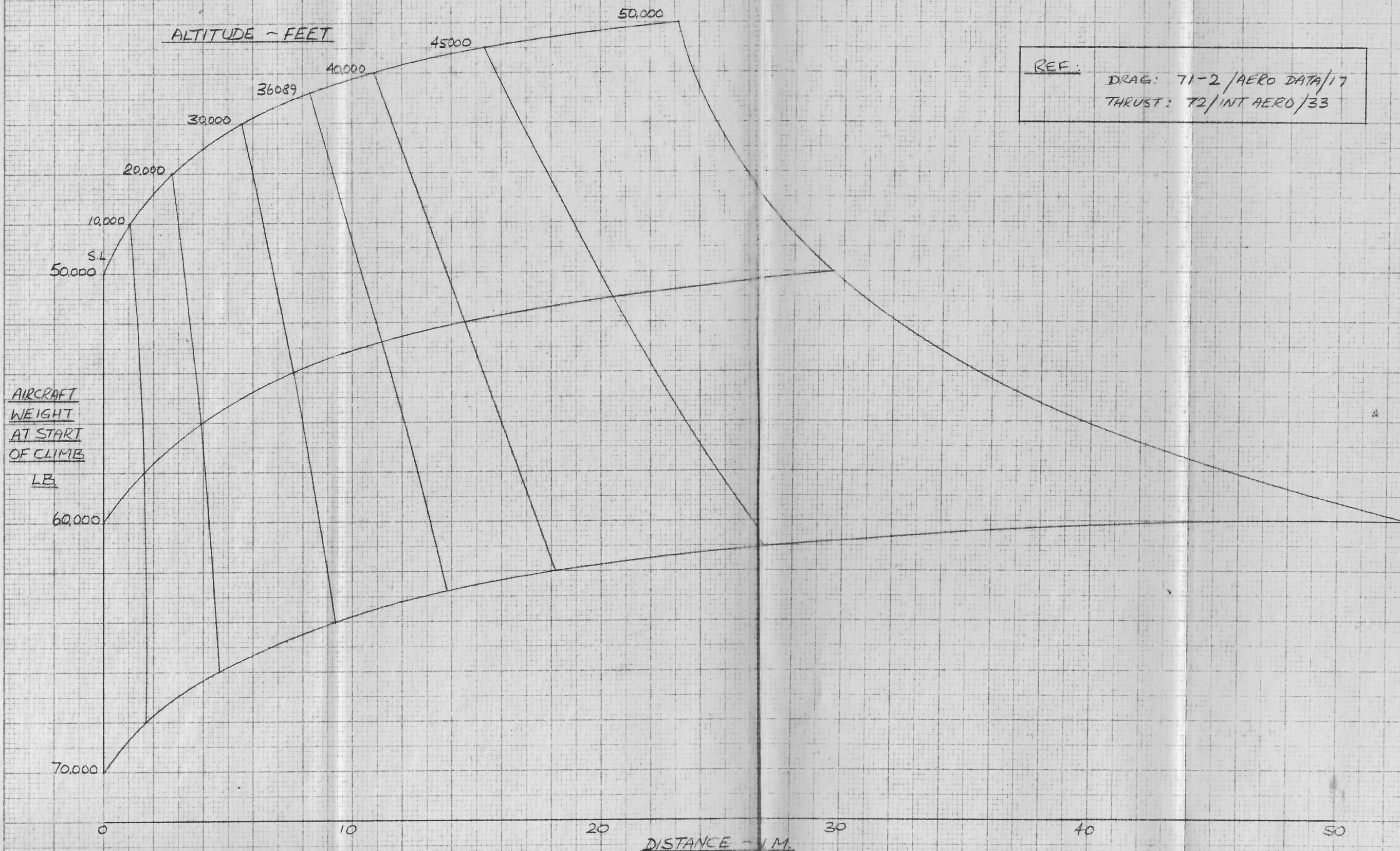
FUEL TO HEIGHT AT $M = .92$ MAXIMUM THRUST A/B LIT



REF :
 DRAG: 71-2/AERO DATA/17
 THRUST: 72/INT AERO/33

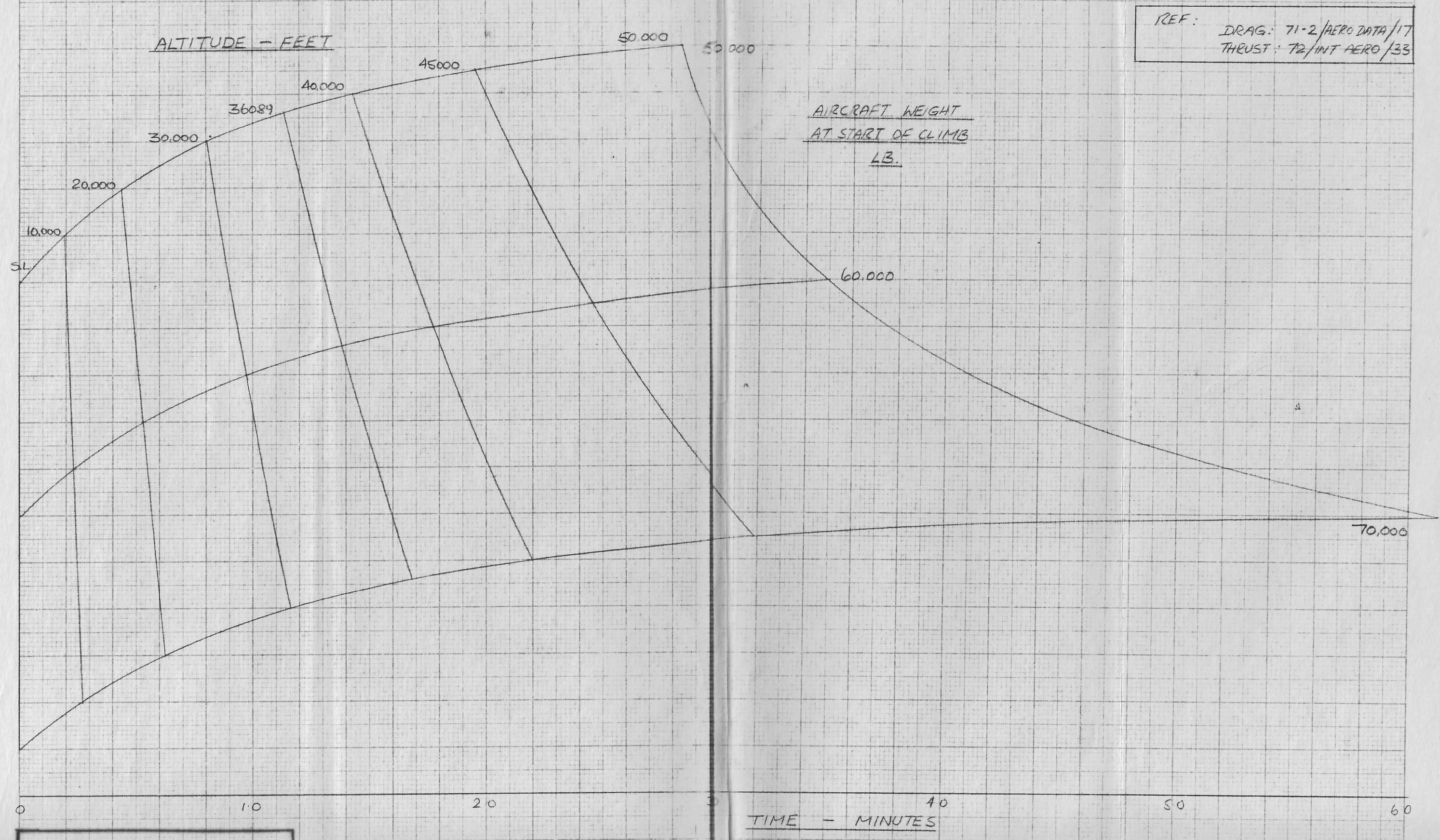
ARROW 2 WITH IROQUOIS SERIES 2 ENGINES

DISTANCE TO HEIGHT AT $M = .92$ MAXIMUM THRUST A/B LIT



ARROW 2 WITH IROQUOIS SERIES 2 ENGINES

TIME TO HEIGHT AT M = .92 MAXIMUM THRUST A/B LIT

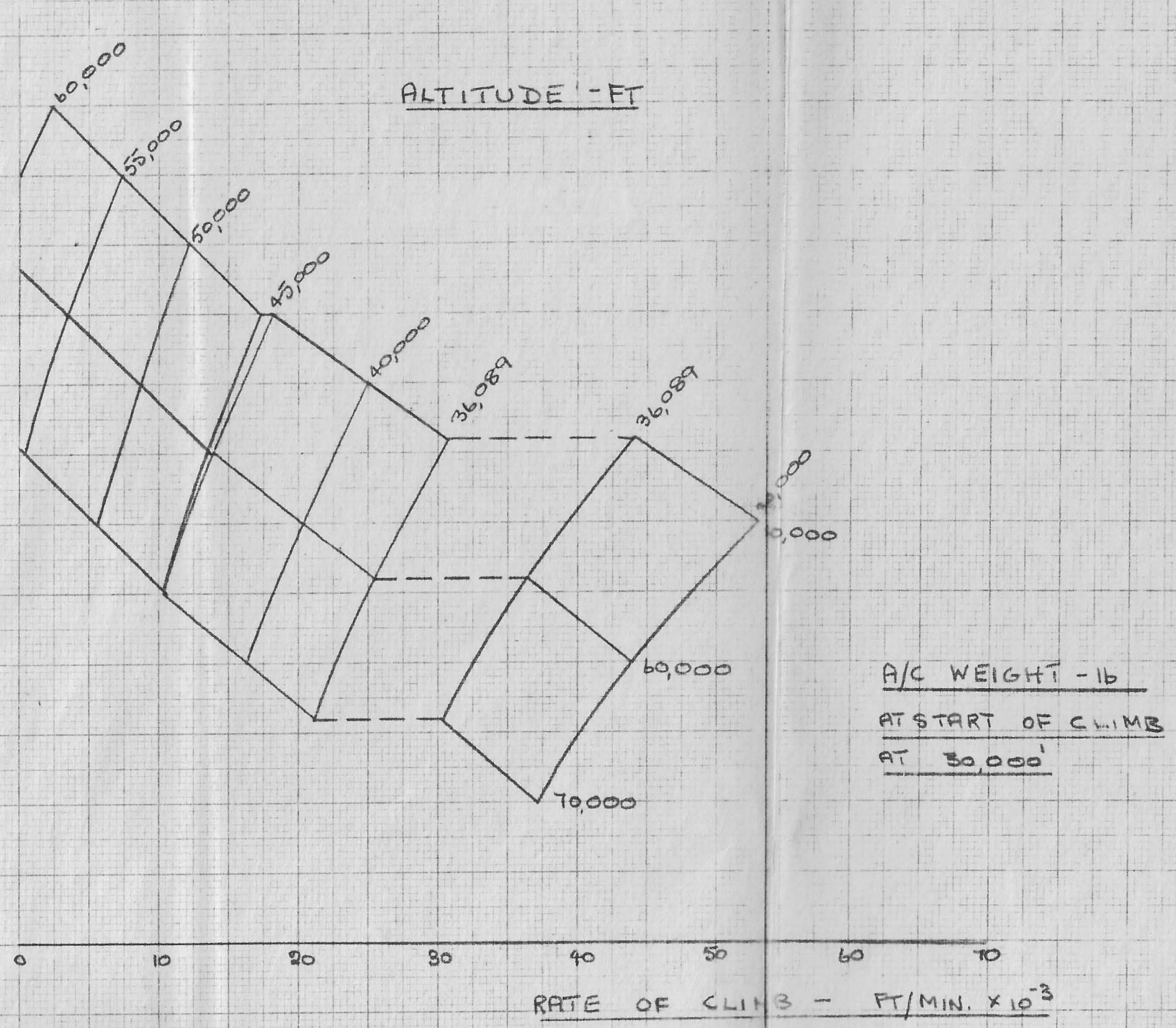


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ARROW 2 - IROQUOIS SERIES 2 ENGINES

RATE OF CLIMB AT M=1.5

A/B LIT



0° AILERON BELOW 45,000'
40° UP AILERON ABOVE 45,000'

REF: DRAG 71-2/AERODATA/17
PROPULSION 72/INT.AERO/33

A/C WEIGHT - 16
AT START OF CLIMB
AT 30,000'

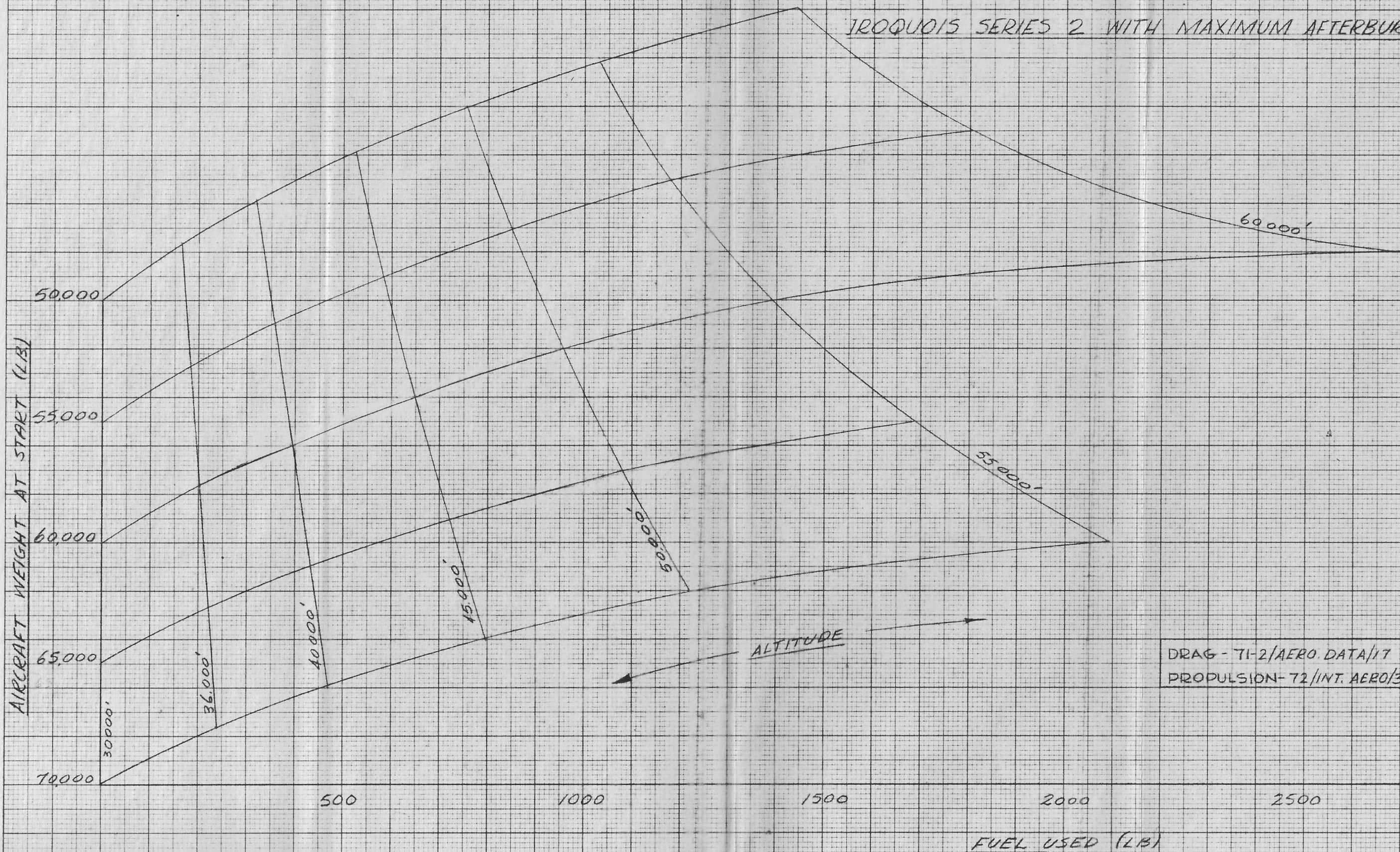
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FIG. 10A

K&E 10 X 10 TO THE 1/2 INCH 359-111L
K&E NEUFEL & ESSER CO. MADE IN U.S.A.

ARROW 2

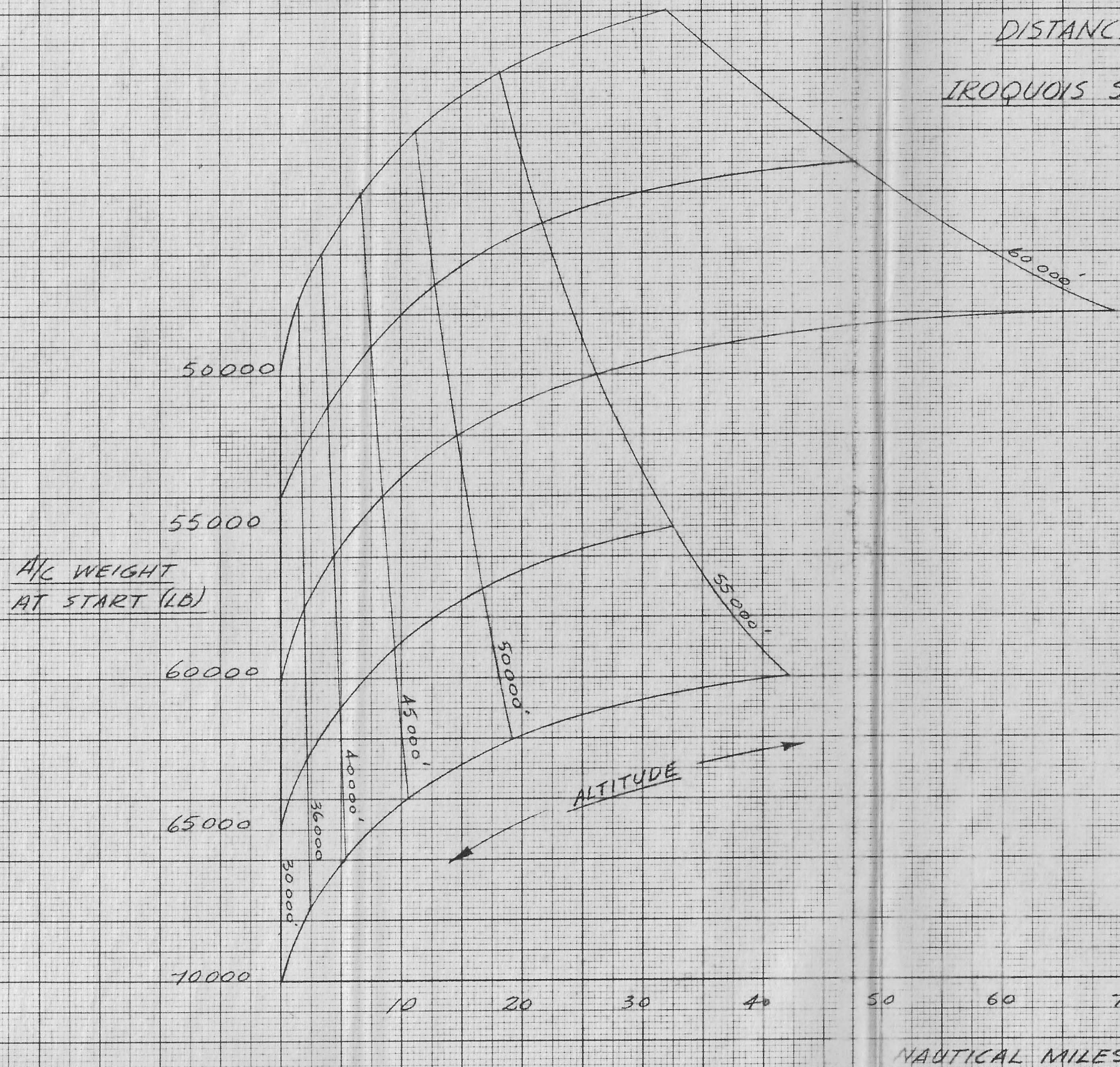
FUEL TO HEIGHT AT CONSTANT MACH No. of 1.5
IROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER



DRAG - T1-2/AERO. DATA/17
PROPULSION - 72/INT. AERO/35

ARROW 2

DISTANCE TO HEIGHT AT CONSTANT MACH No 1.5
IROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER



DRAG - 71-2/AERO DATA/17
PROPULSION - 72/INT. AERO/33

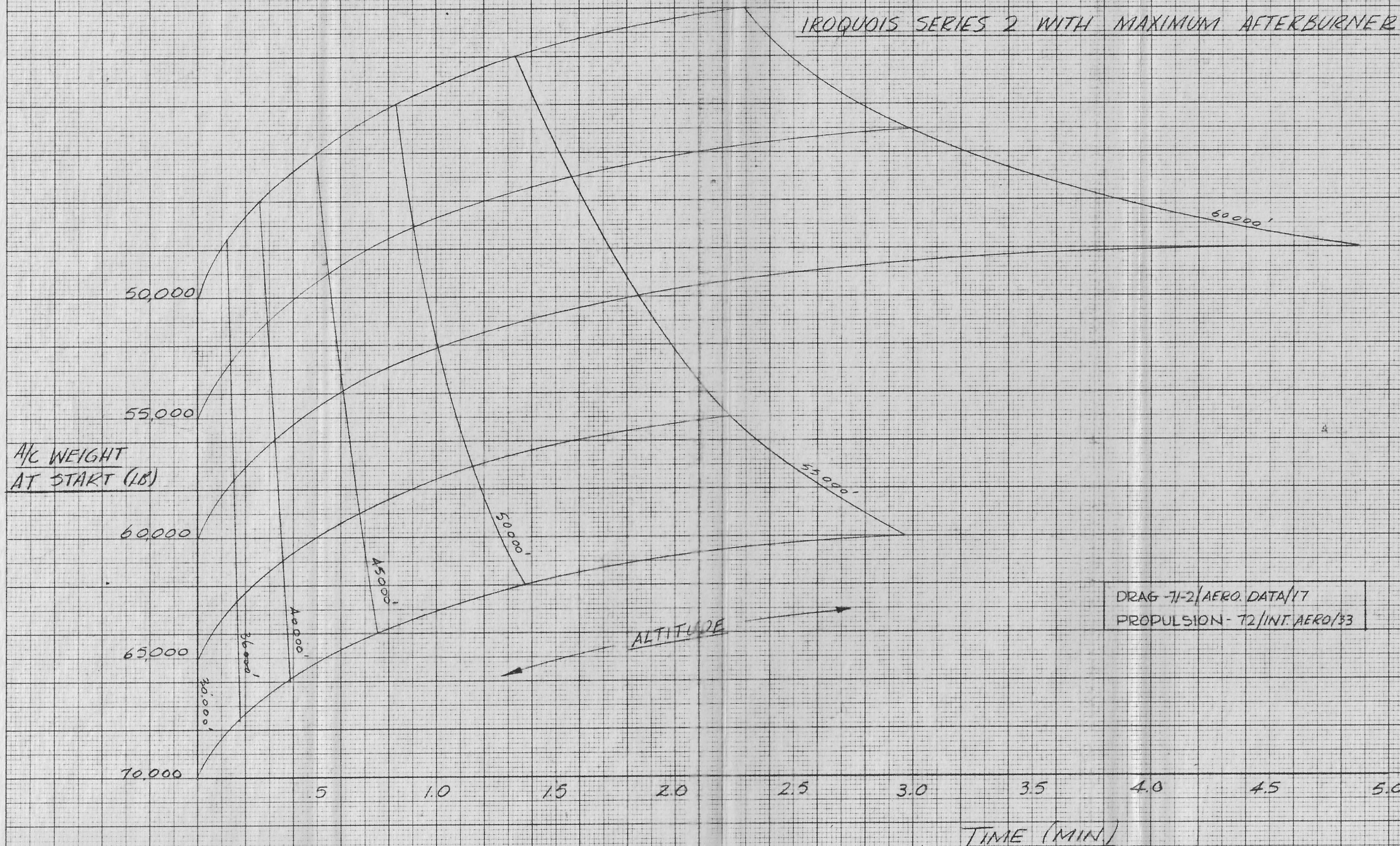
G9-11L
10 X 10 to the 1/2 inch, 5th lines accented
MADE IN CANADA



ARROW 2

TIME TO HEIGHT AT CONSTANT MACH No. of 1.5

IROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER



DRAG - 71-2/AERO. DATA/17
PROPULSION - T2/INT. AERO/33

ALTITUDE

TIME (MIN)

UNCLAS SECRET ID

FIG. 10D

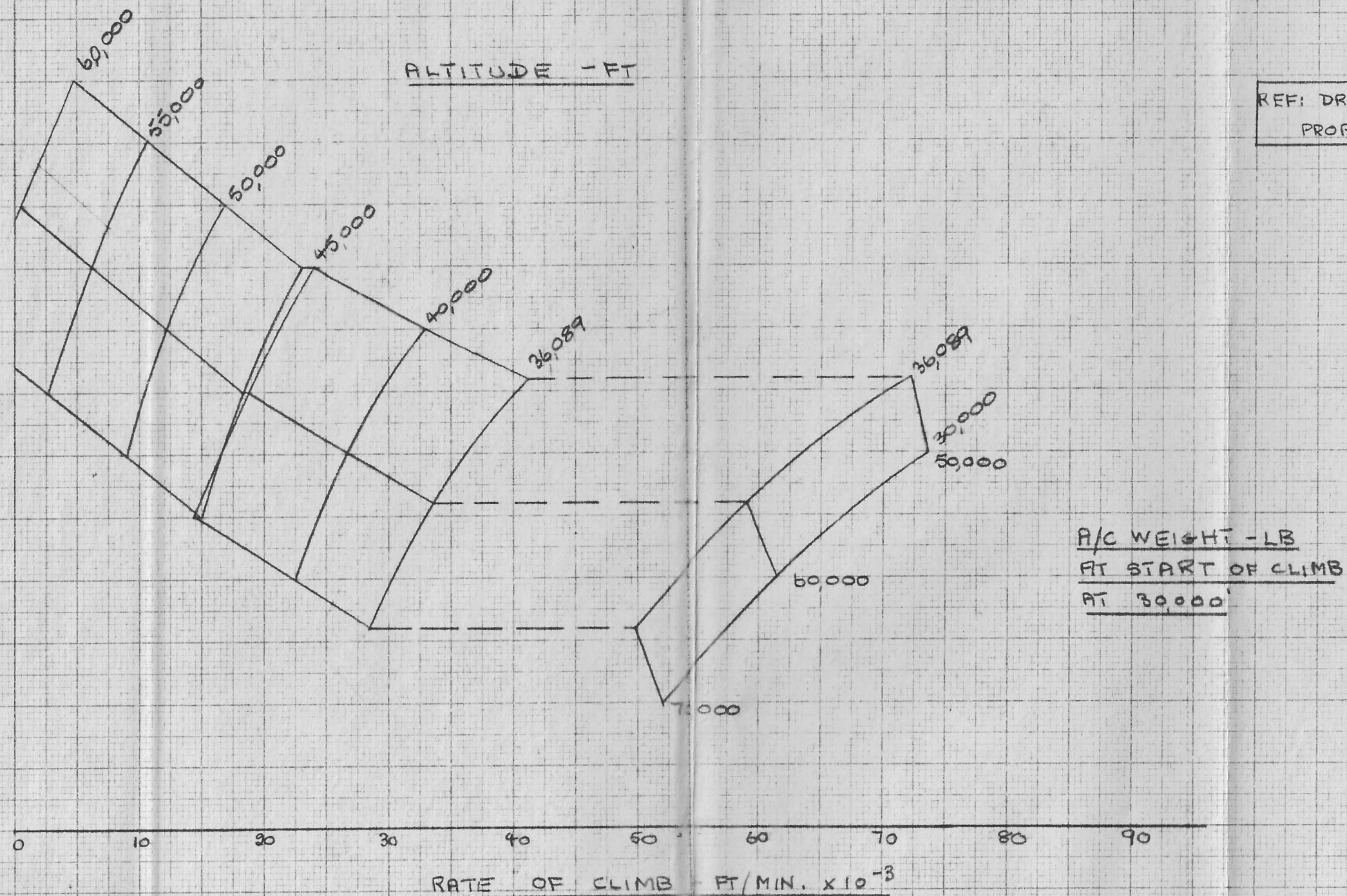
ARROW 2 - IROQUOIS SERIES 2 ENGINES

RATE OF CLIMB AT M = 1.8

A/B LIT

0° AILERON BELOW 45,000'
4° UP AILERON ABOVE 45,000'

REF: DRAG 71-2 | AERO DATA 17
PROPULSION 72 | INT. AERO 33



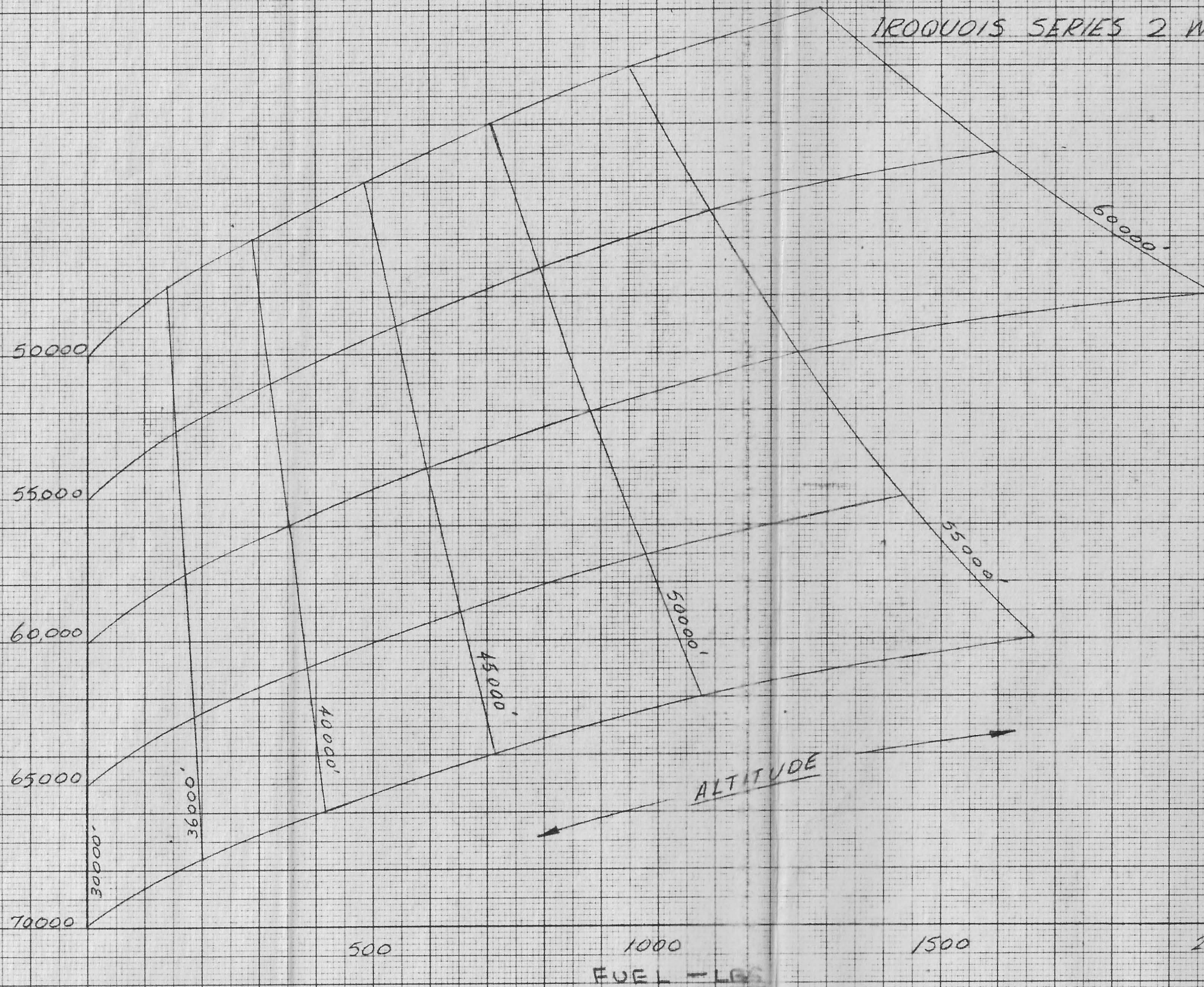
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FIG. 11 A

ARROW 2

FUEL TO HEIGHT AT CONSTANT MACH No of 1.8

IROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER



DRAG - '71-2/AERO DATA/17
PROPULSION - '72/INT. AERO/33

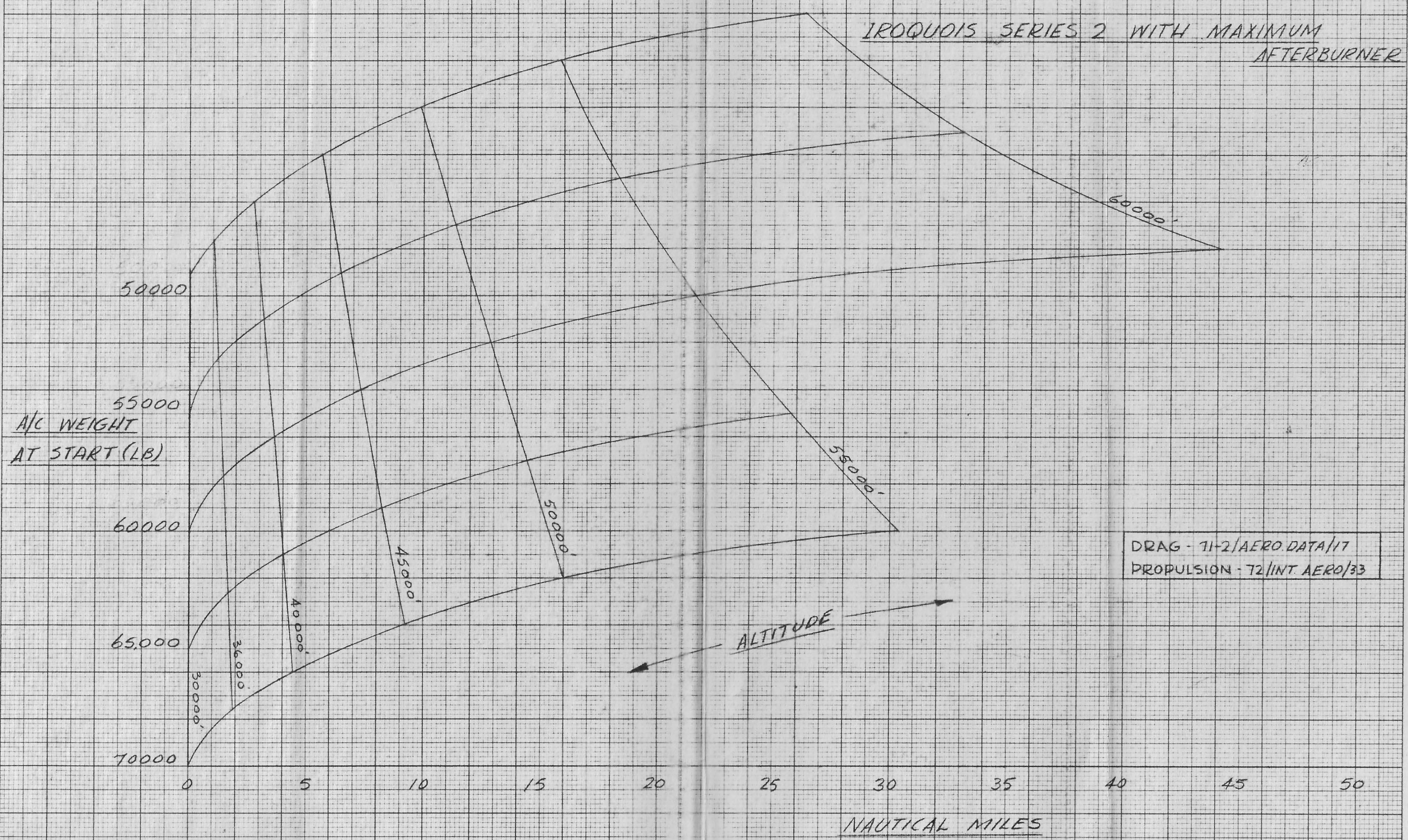
UNCLASSIFIED

FIG. 11 B

ARROW 2

DISTANCE TO HEIGHT AT CONSTANT MACH No 1.8

IROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER

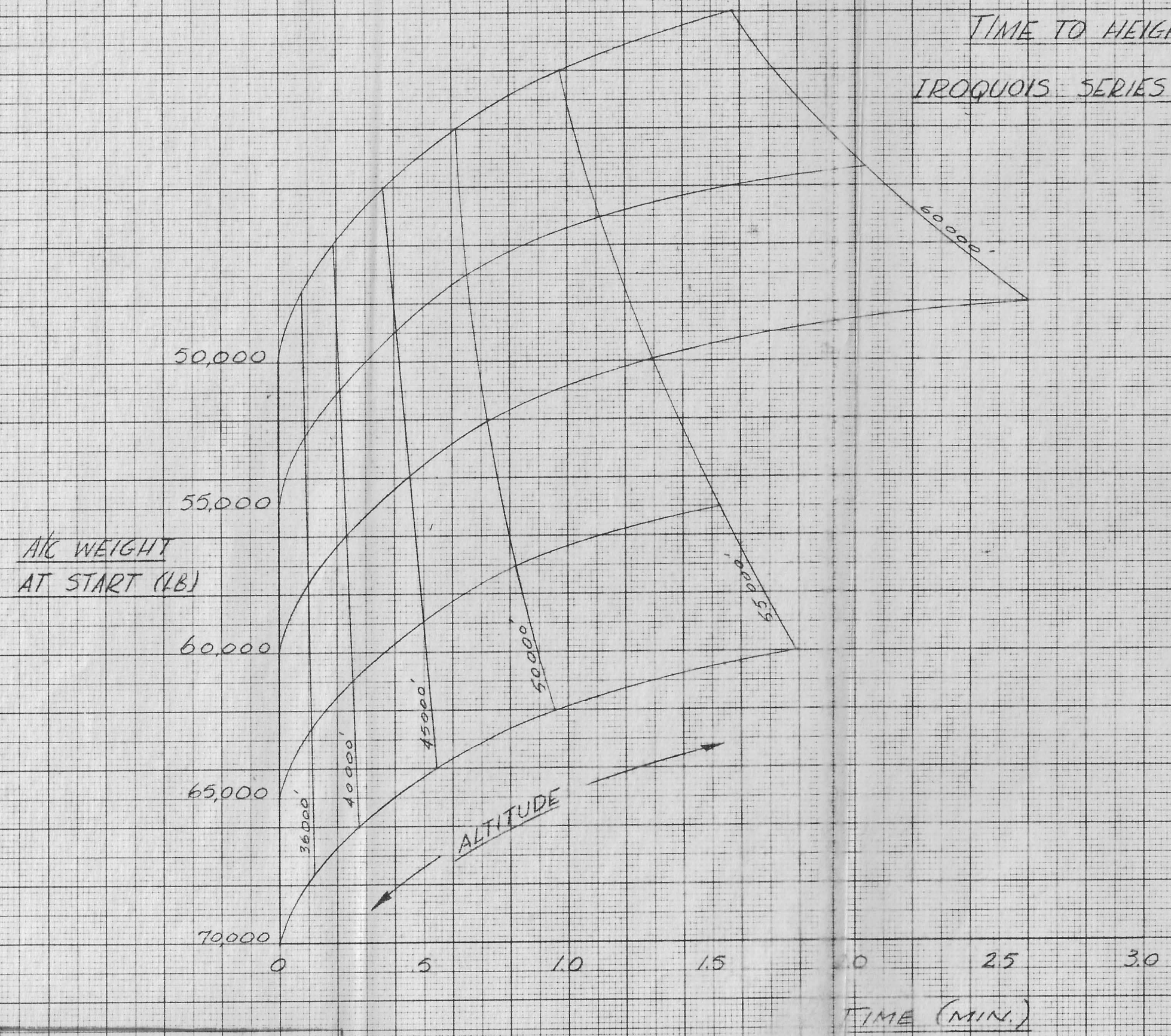


G9-11L
10 X 10 to the 1/2 inch, 5th lines accented
MADE IN CANADA



ARROW 2

TIME TO HEIGHT AT CONSTANT MACH No. of 1.8
IROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER



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FIG. 11D

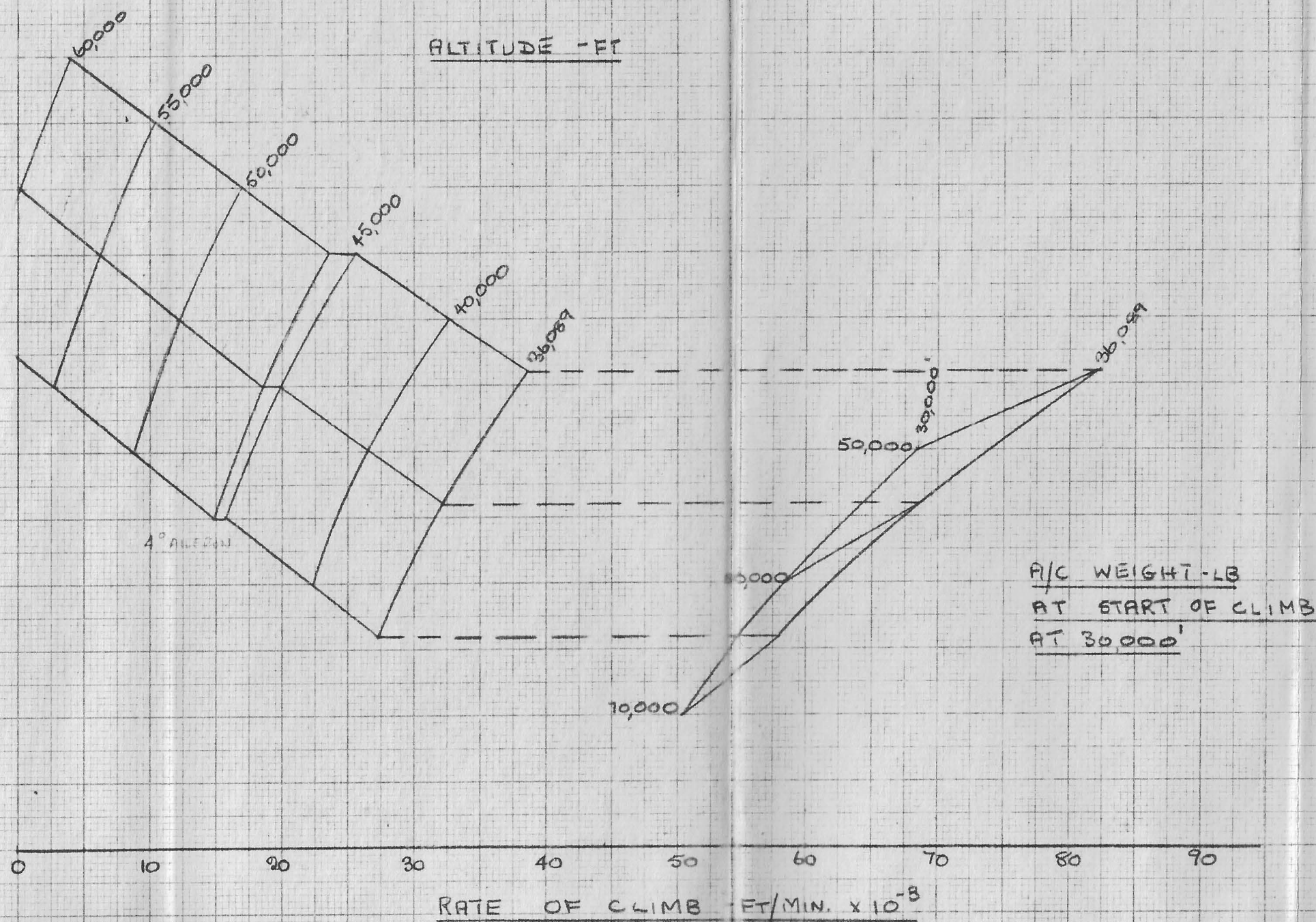
ARROW 2 - IROQUOIS SERIES 2 ENGINES

RATE OF CLIMB AT $M=2.0$

A/B LIT

0° AILERON BELOW 45,000'
4° UP AILERON ABOVE 45,000'

REF: DRAG 71-2/AERO DATA/17
PROPULSION 72/INT.AERO/33





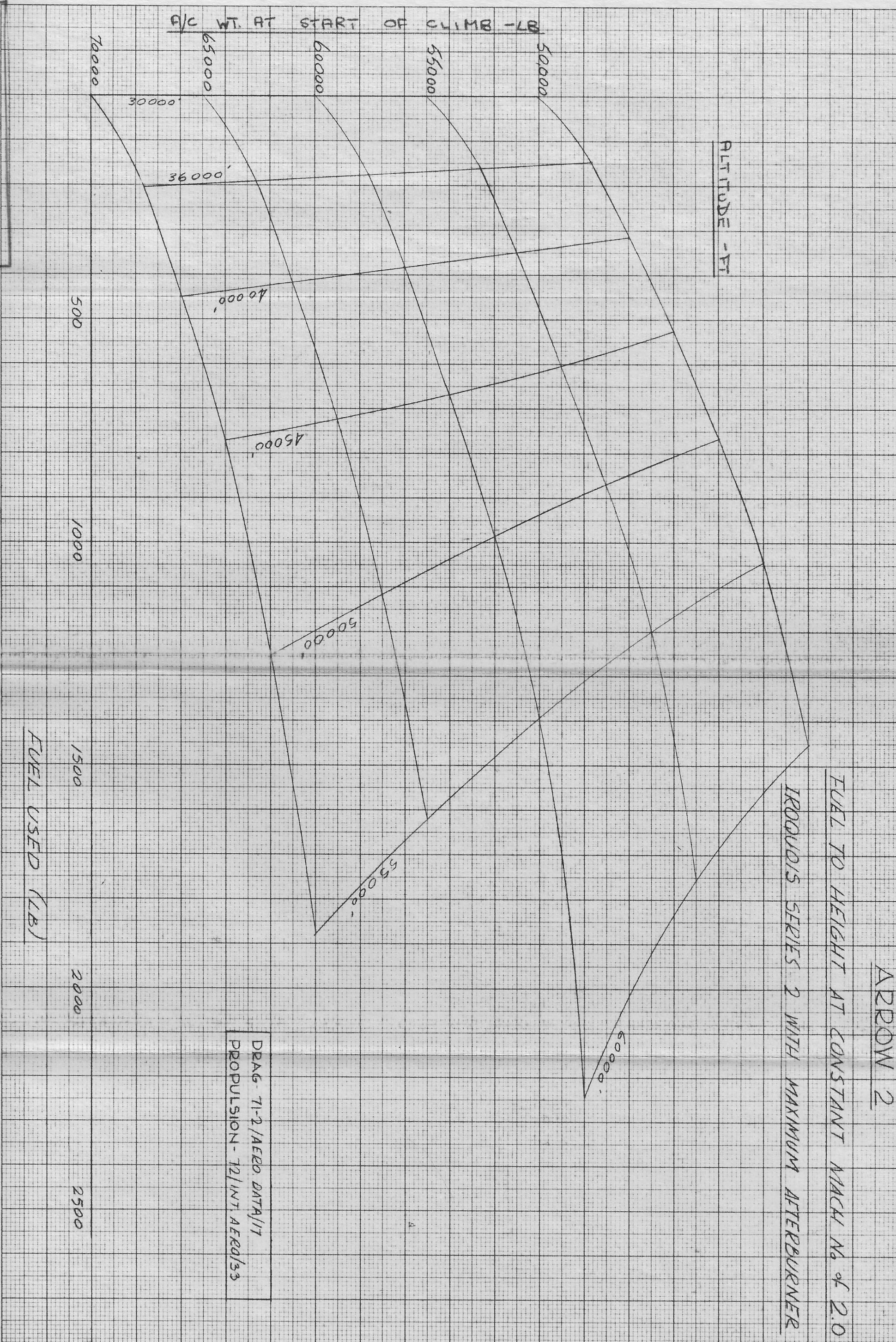
-41-

REPORT NO: 72/PERF/36

ARROW 2

FUEL TO HEIGHT AT CONSTANT MACH No. of 2.0

IRROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER



DRAWN - 71-2/AERO DATA/IT
PROPULSION - 72/INT. AERO/53

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FIG. 12B

ARROW 2

DISTANCE TO HEIGHT AT CONSTANT MACH No. of 2.0

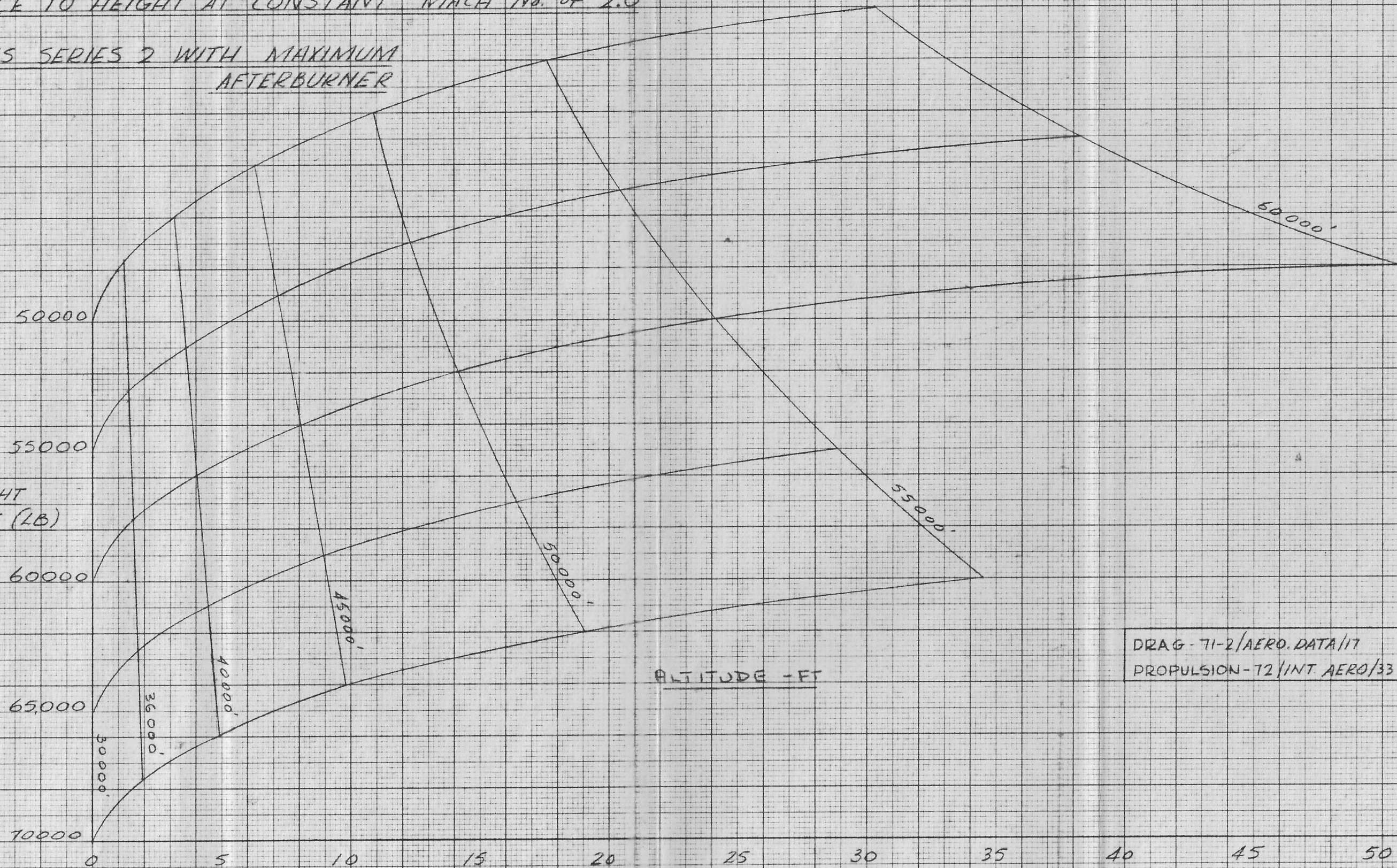
IROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER

A/C WEIGHT AT START (LB)

ALTITUDE - FT

DISTANCE - N.M.

DRAG - 71-2/AERO. DATA/17
PROPULSION - 72/INT. AERO/33



ARROW 2

TIME TO HEIGHT AT CONSTANT MACH No. of 2.0

IROQUOIS SERIES 2 WITH MAXIMUM AFTERBURNER

A/C WEIGHT
AT START (LB)

50,000

55,000

60,000

65,000

70,000

0

.5

1.0

1.5

2.0

2.5

3.0

TIME (MIN.)

ALTITUDE

DRAG - 71-2/AERO DATA/17
PROPULSION - 72/INT.AERO/33

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FIG. 12D

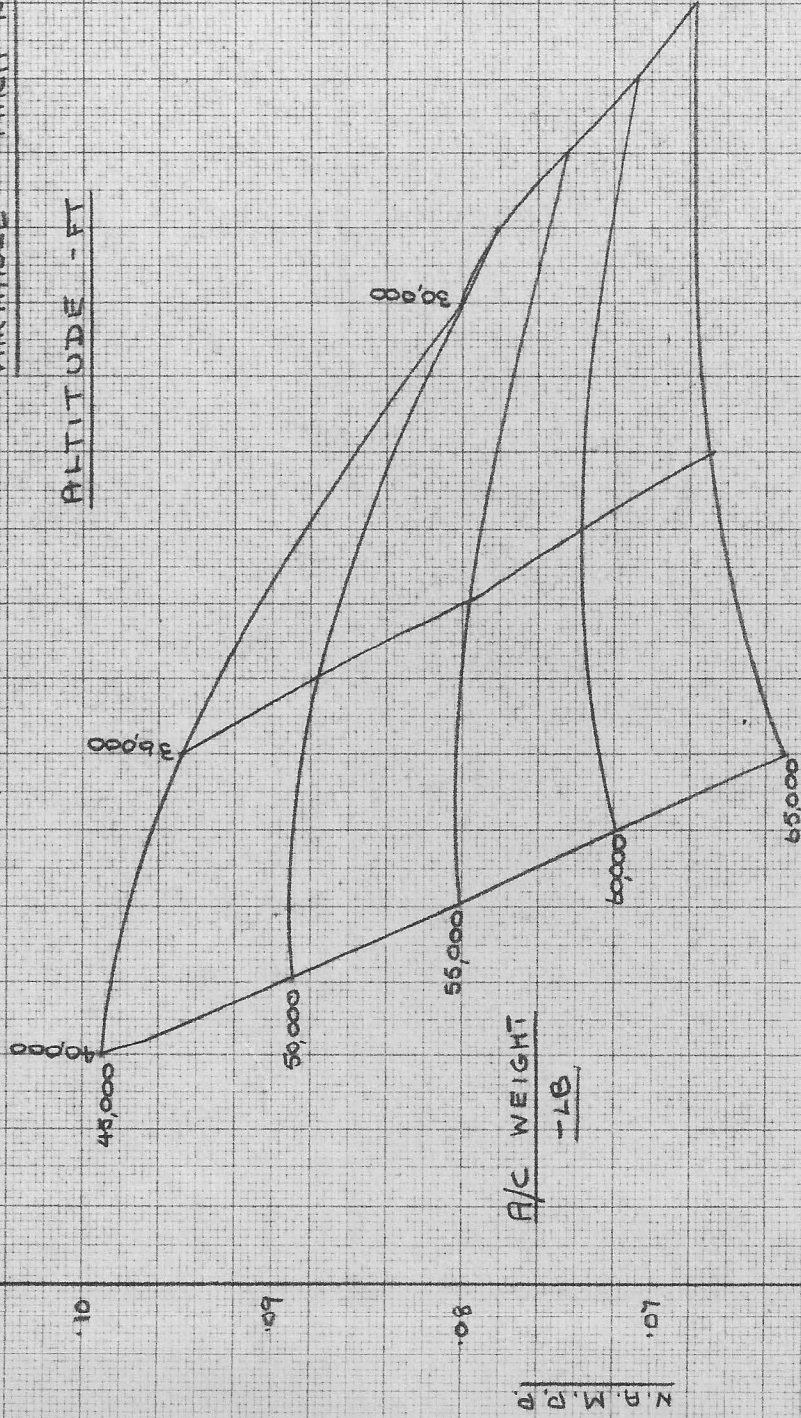
ARROW 2 IROQUOIS SERIES 2 ENGINES

A/B UNLIT NO VENTRAL TANK

CRUISE AT 99% MAX. N.A.M.P.P.

VARIABLE MACH NUMBER

ALTITUDE - FT



REF: PROPULSION 72/INT.AERO/33
DRAG 71-2/AERO DATA/17

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FIG. 13

ARROW 2 IROQUOIS SERIES 2 ENGINES

CRUISE AT 99% MAX. N.A.M.P. WITH VARIABLE

MACH NUMBER

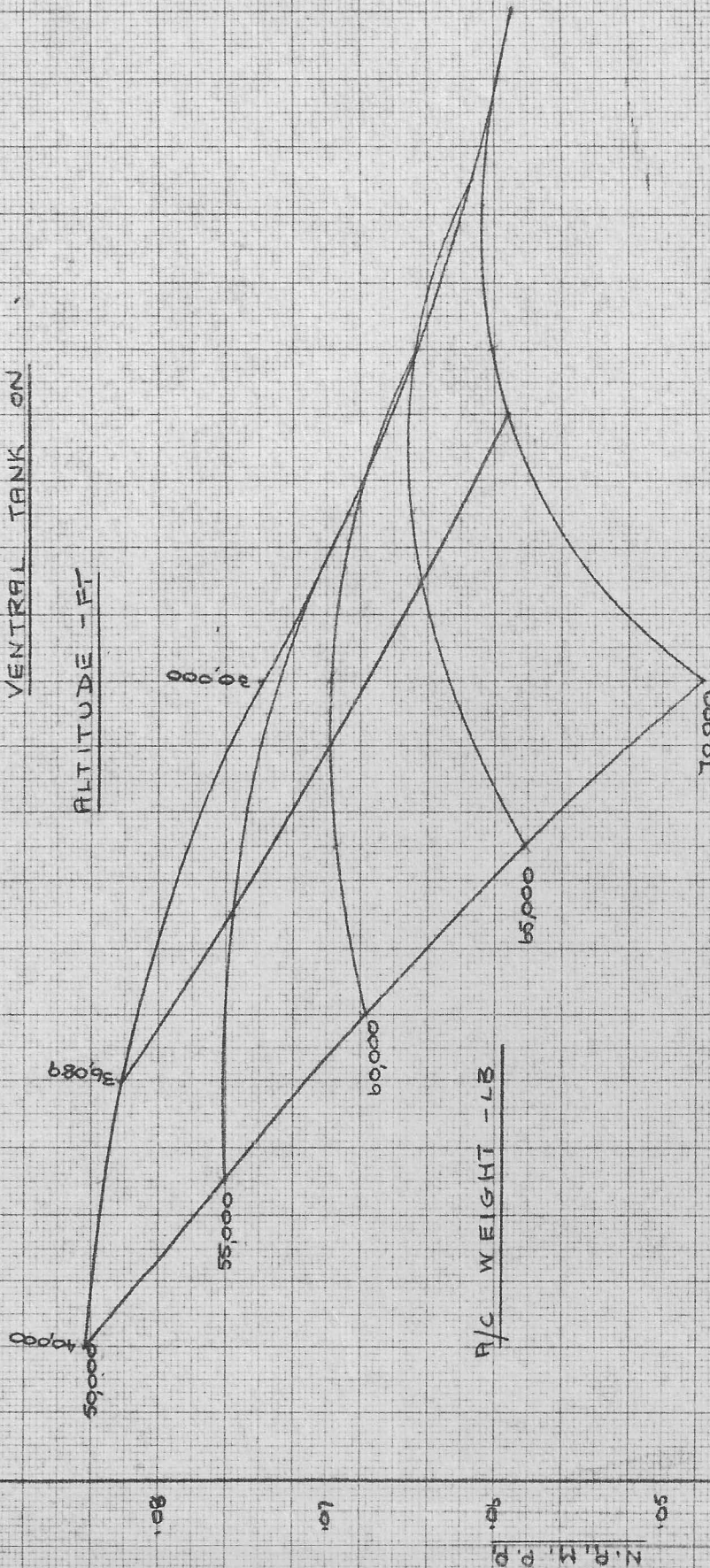
VENTRAL TANK ON

ALTITUDE - FT

A/C WEIGHT - LB

REF: PROPULSION 42/INT. AERO/33
DRAG 71-2/AERO DATA/17

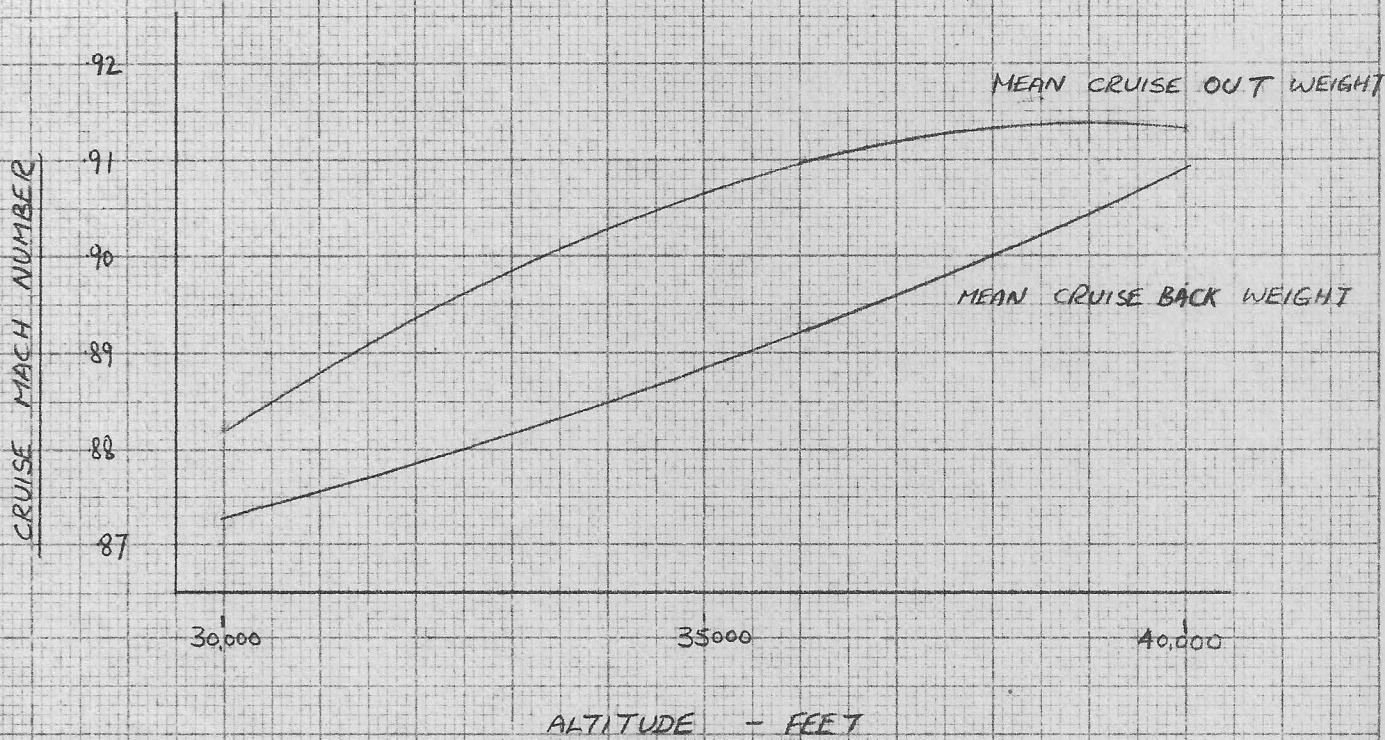
N.W. NOV '58



ARROW 2 WITH IROQUOIS SERIES 2 ENGINES

CRUISE MACH NUMBER

REF: DRAG 72-2/PERO DATA/17
THRUST 72/INT AERO/33



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SECRET

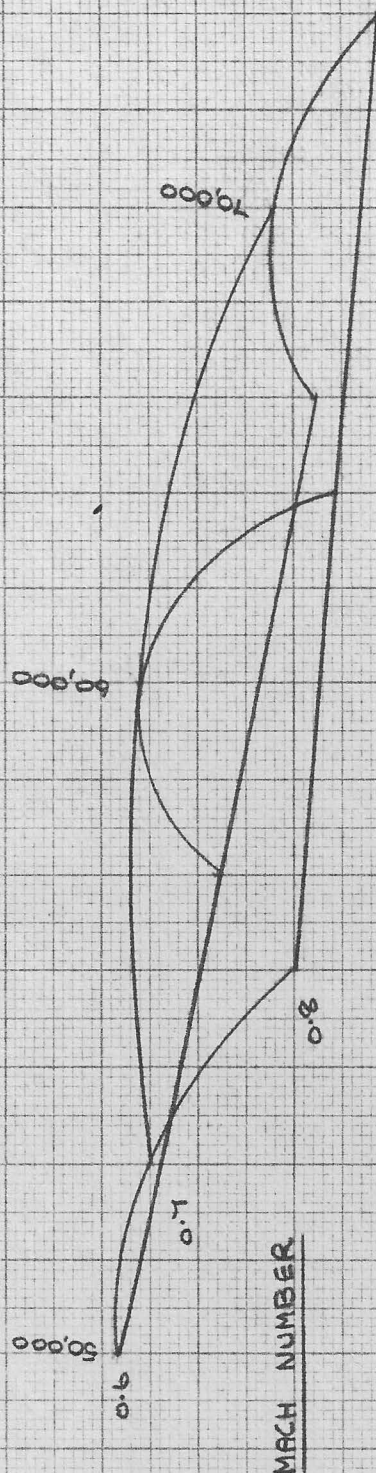
FIG. 15

ARROW 2 IROQUOIS SERIES 2 ENGINES

CRUISE AT 10,000' 99% N.A.M.P.P.

A/B UNLIT NO VENTRAL TANK

Wt WEIGHT - LB

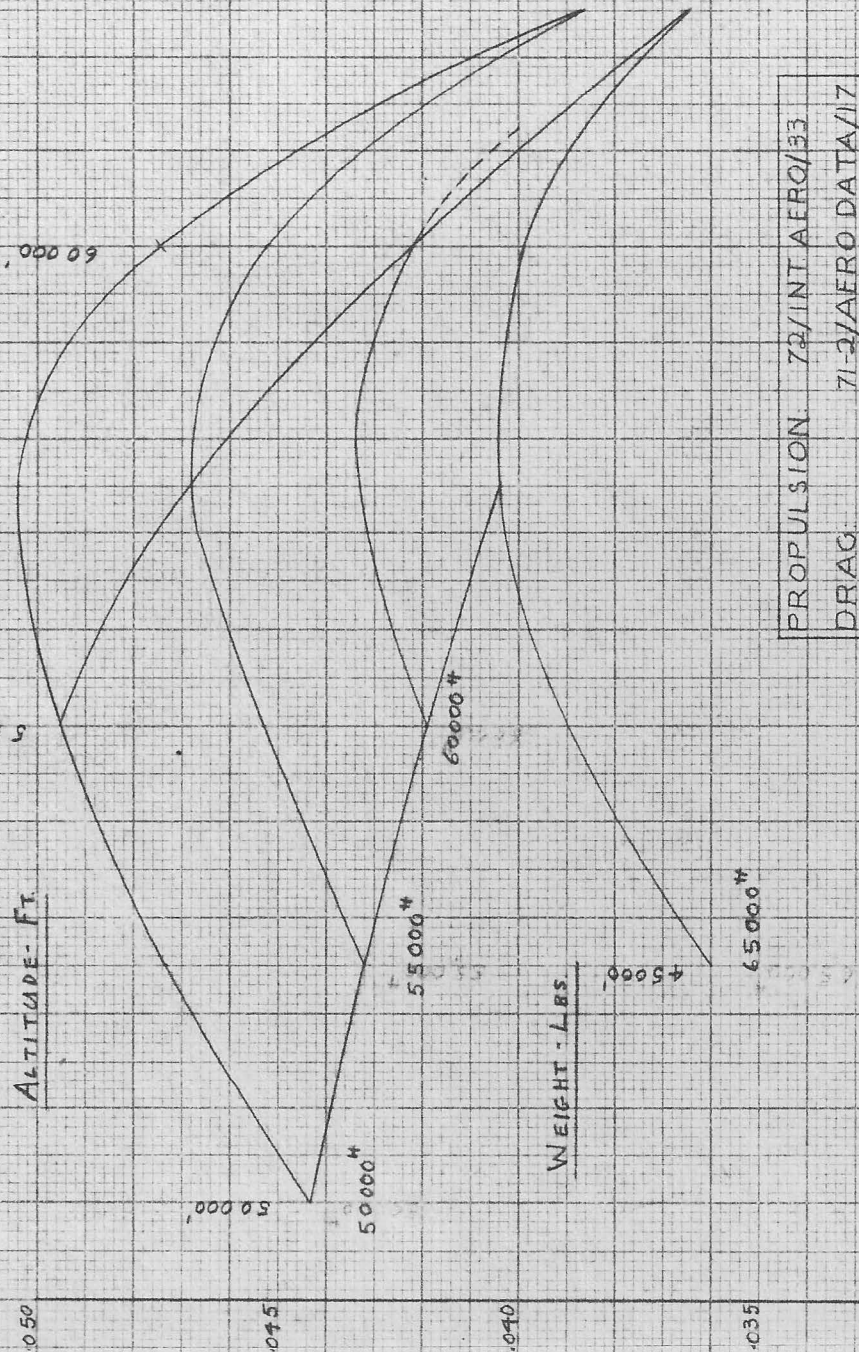


REF: PROPULSION Y2/INT. AERO/33
DRAG 71.2 / AERO DATA/17

UNCLASSIFIED

FIG. 16

ARROW 2 IROQUOIS SERIES 2
99% MAX NAMPP M-1.5 A/B LIT



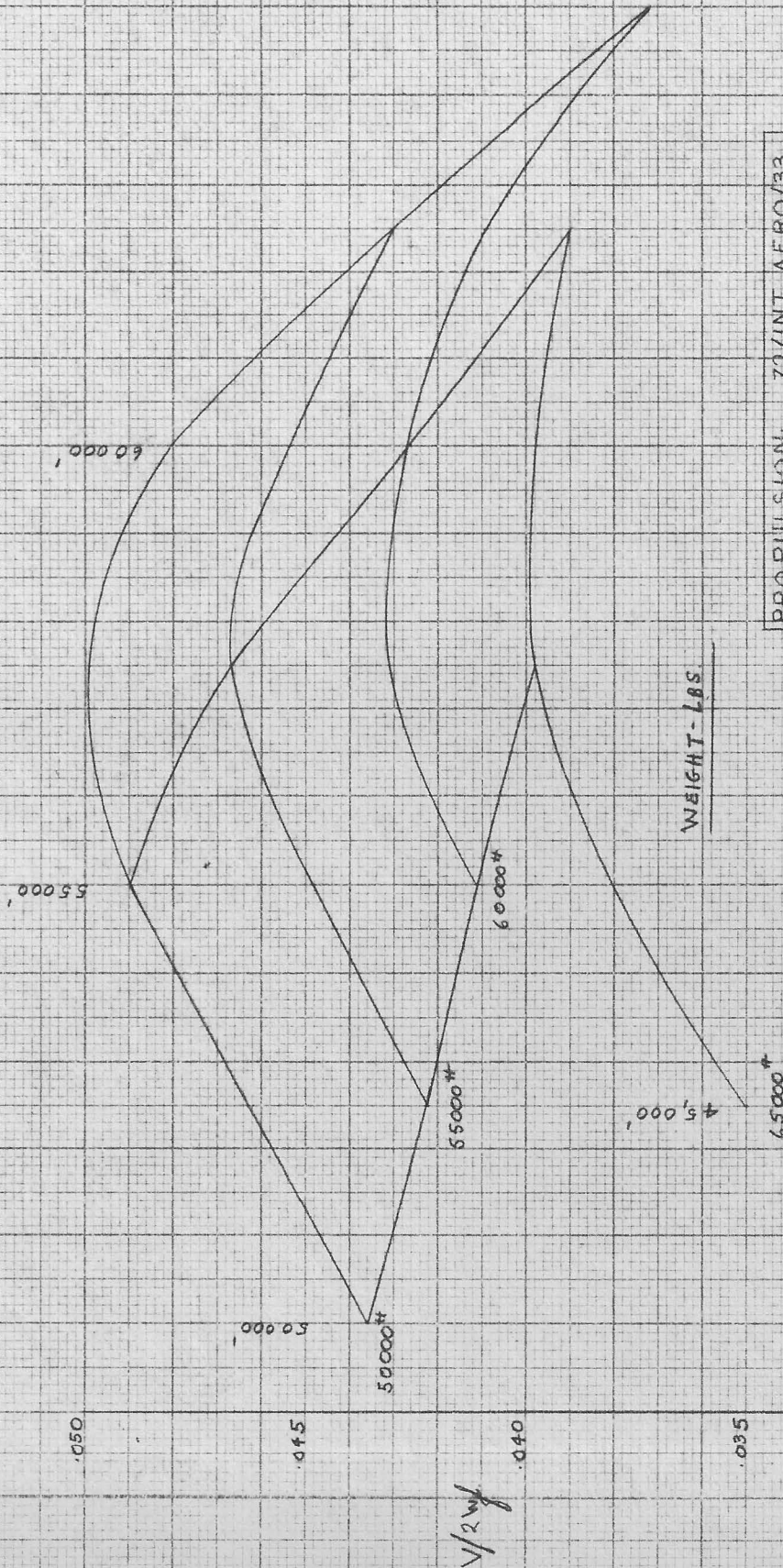
PROPULSION: 72/INT AERO/33
DRAG: 71-2/AERO DATA/17

UNCLASSIFIED SECRET

FIG. 17

ARROW 2 IROQUOIS SERIES 2
99% MAX NAMPP M-18 A/B LIT

ALTITUDE - FT.



PROPULSION: 72/INT. AERO/33

DRAG: 71-2/AERO DATA/17

WEIGHT - LBS.

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FIG. 18

Arrow 2

INQUIS SERIES 2

99% MAX NAMPP M=2.0 A/B/LIT

ALTITUDE-FT

WEIGHT-LB

PROPULSION: 72/INT AERO/33
DAG: 71-2/AERO DATA/17

.050

.045

.040

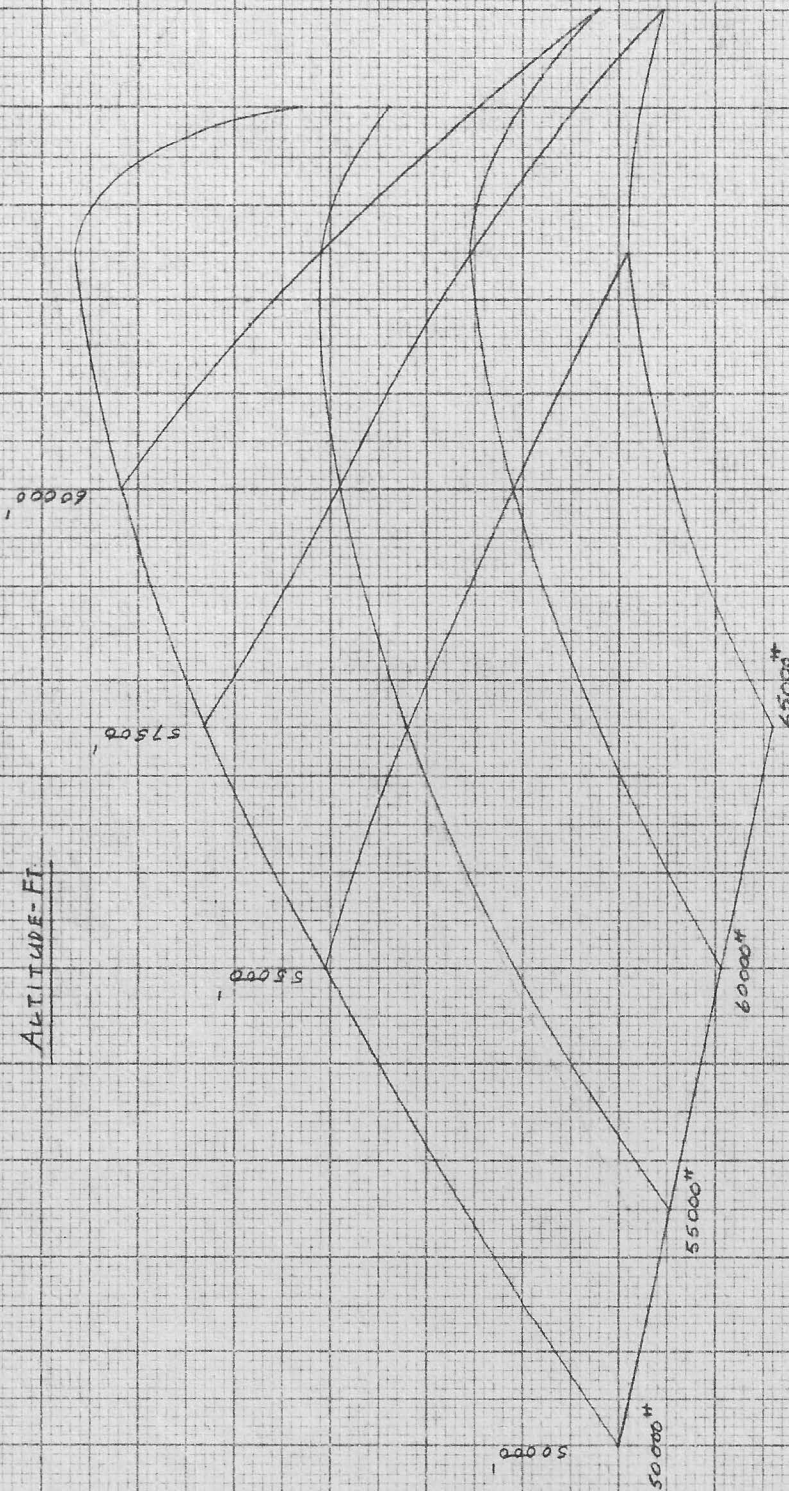
.035

.030

1/2uf

UNCLASSIFIED

FIG. 19



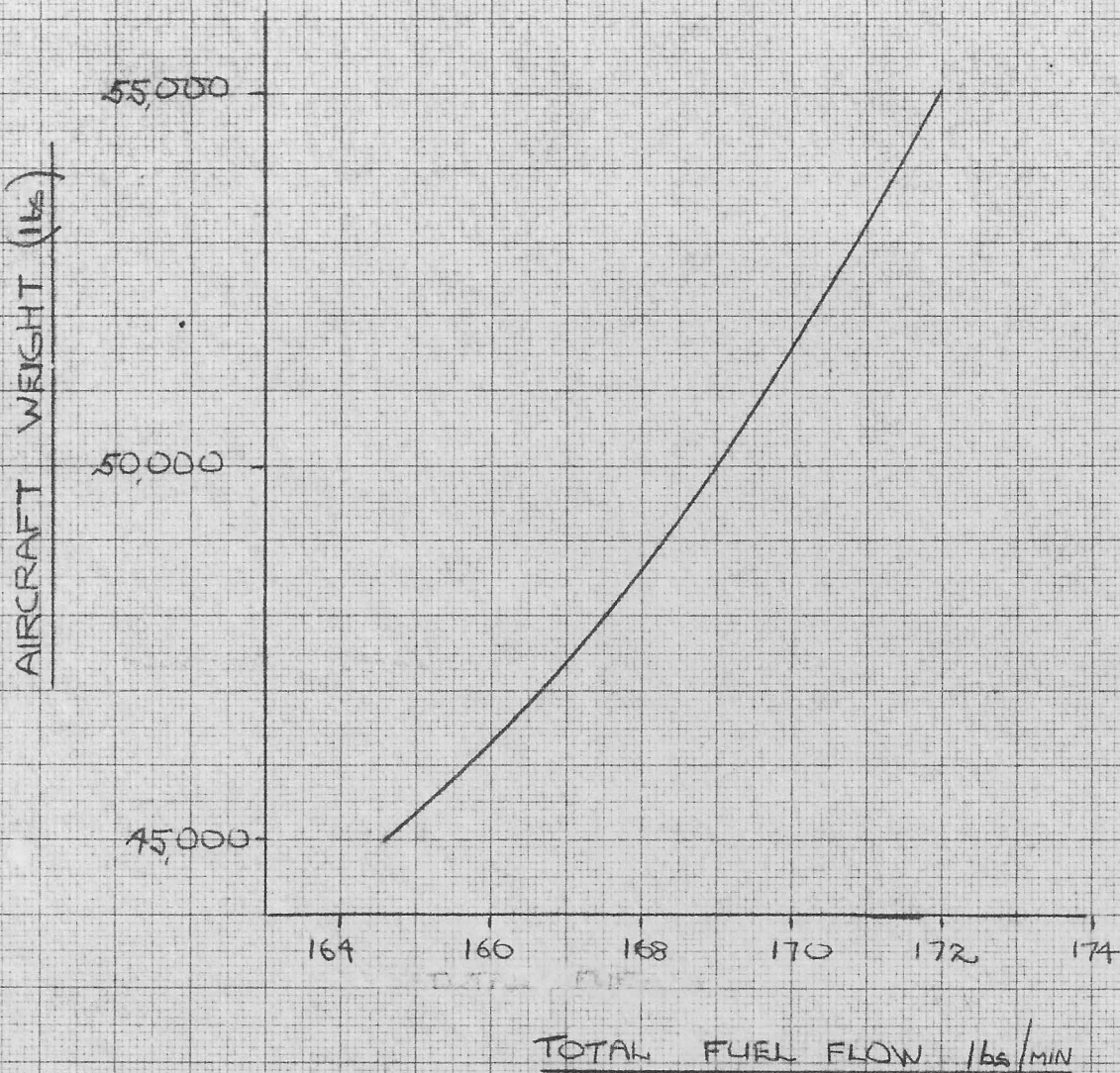
- 51 -

72/PERF/36

ARROW 2 WITH IROQUOIS SERIES 2 ENGINES

LOITER AT M=0.4 AT SEA LEVEL

DRAG 71-2/AERO DATA/17
PROPULSION 72 INT AERO/33



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FIG. 20

ARROW 2 - IROQUOIS SERIES 2 ENGINES
LOITER AT OPTIMUM MACH NO

AT ALTITUDE 55,000

WEIGHT (lbs)

50,000

45,000
30,000

ALTITUDE

40,000

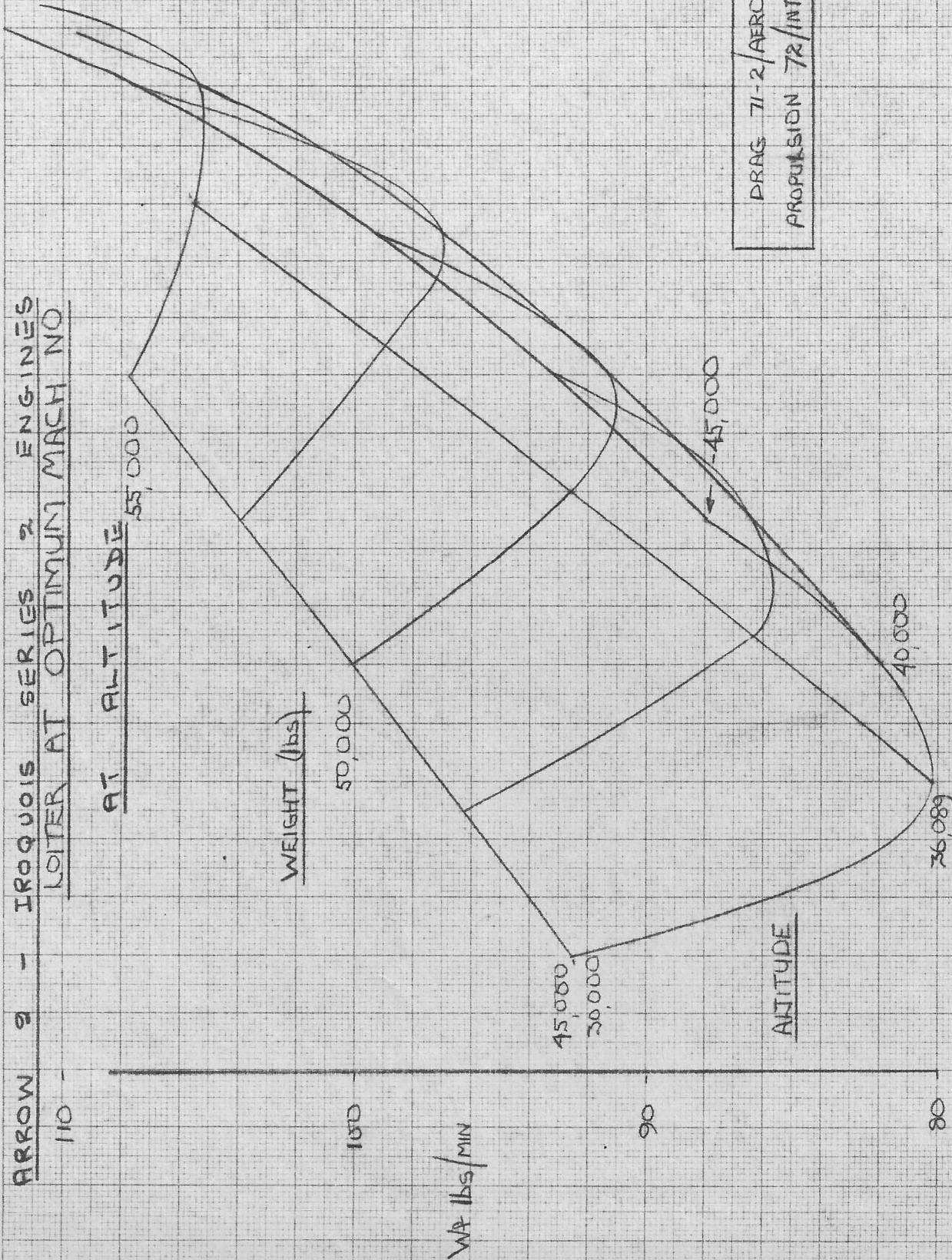
36,089

← 45,000

PRAG 71-2/AERO DATA 17
PROPULSION 72/INT AERO/33

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FIG. 21



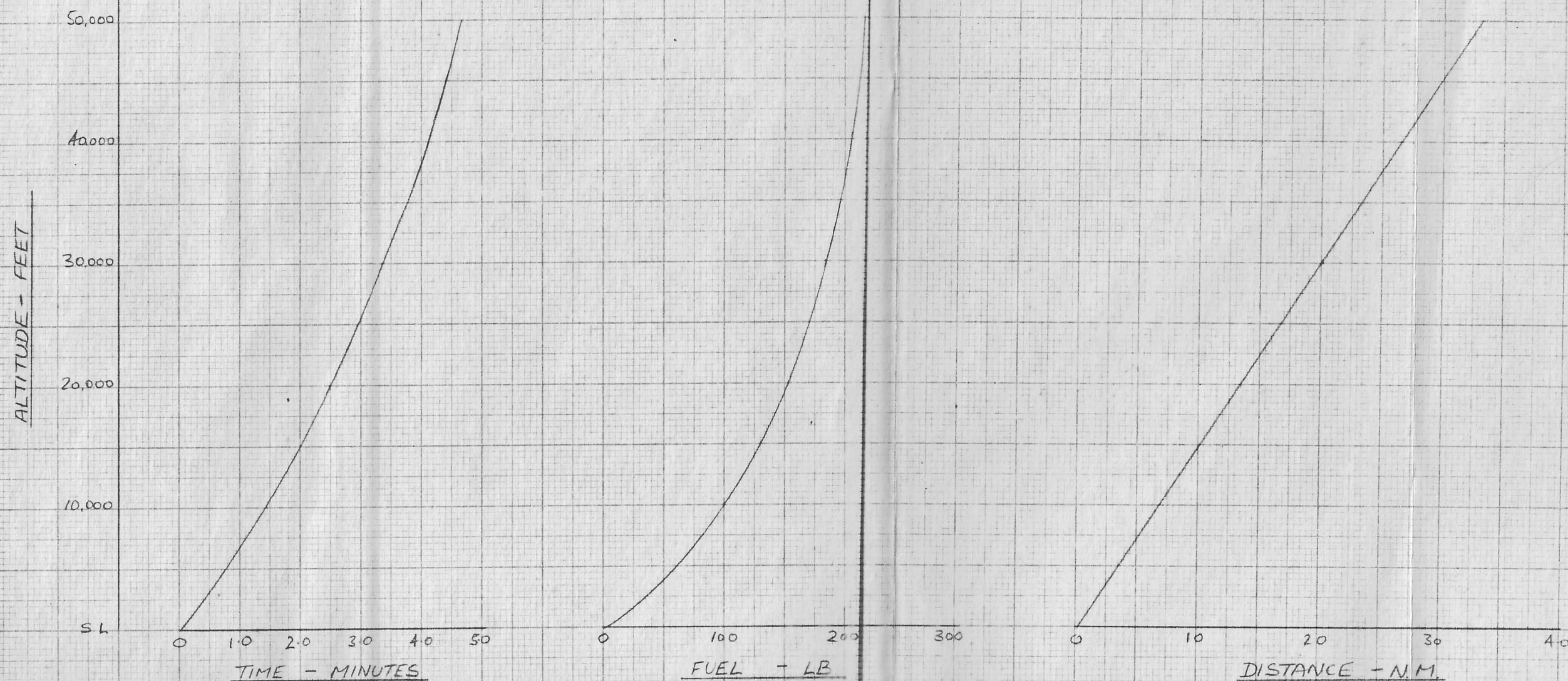
ARROW 2 WITH IRROQUOIS SERIES 2 ENGINES

DESCENT FROM 50,000 FT TO S.L.

DESCENT TECHNIQUE : $1.1 V_{D_{MIN}}$, $M = 2.0$, AIR BRAKES EXTENDED

$W = 45500 \text{ lb}$

REF : THRUST : 72/INT AERO/33
DRAG : 71-2/AERO DATA/17



ARROW 2 WITH IROQUOIS SERIES 2 ENGINES

AVAILABLE STEADY 'G' AT COMBAT WEIGHT

MAX. THRUST A/B LIT

COMBAT WEIGHT = 56,699 LB

REF:

THRUST 72/INT AERO/33
DRAG 71-2/AERO DATA/17

ALTITUDE - FT/1000

4° UP AILERON
DEFLECTION

NO AILERON
DEFLECTION

M = 0.8

1.8
1.6
1.4
1.2
1.0
0.95
0.9

40

30

20

10

n

SECRET SSIFIED

FIG. 23