

JANUARY 1958

SECRET

Preliminary
PILOT'S OPERATING INSTRUCTIONS
ARROW 1
AVRO AIRCRAFT LIMITED



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ARROW 1

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MALTON - ONTARIO

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PART 4

OPERATING DATA

ENGINE LIMITATIONS

Principal Limitations

1. The principal limitations of the Pratt and Whitney J-75 P3 engines are:

Condition	Maximum Observed Turbine Discharge Temp °C	Time Limit (Minutes)
MAXIMUM (With A/B)	610	Fifteen
MILITARY	610	Thirty
NORMAL RATED	540	UNRESTRICTED
CRUISE		
90% NORMAL RATED	540(max) 500(normal)	UNRESTRICTED
80% NORMAL RATED	540(max) 460(normal)	UNRESTRICTED
70% NORMAL RATED	540(max) 410(normal)	UNRESTRICTED
IDLE	340	UNRESTRICTED
STARTING	600	MOMENTARY
TRANSIENT	625	One

FLYING LIMITATIONS

General

2. The following speeds and limitations apply to the ARROW 1 aircraft when fully cleared to its design specification. Until such clearance is obtained, the applicable aircraft design certificate must be studied prior to flight to obtain the overriding limitations to those given below.

Maximum Permissible Speeds

3. The principal limitations are:

Maximum Design Speed	-	700 Knots EAS or Mach 2.0 (Lowest limit to apply)
Extending or Retracting Landing Gear	-	250 Knots EAS <i>← should be 185</i>
Extending Speed Brakes	-	No limit
Parabrake Selection	-	185 Knots EAS (All wheels in ground contact). <i>15k-1</i>
Cross-wind Component	-	30 Knots

Crew Ejection

Maximum speed	-	No structural limit. <i>mm</i>
Minimum speed	-	80 knots at ground level.

Handling Speeds

Raise nose wheel at take-off	-	10 Knots below the applicable take-off speed.
Take-off		
With Afterburner	-	See Fig 4-9
Without Afterburner	-	See Fig 4-9
Optimum Climb	-	Mach .92
Approach	-	See Fig 4-10
Touchdown	-	See Fig 4-11

AIRCRAFT ARROW 1		CLIMB CHART WITH AFTERBURNERS								ENGINES J 75 - P 3	
MAXIMUM THRUST - ENGINE START GROSS WT. - 60,000 LB.											
PRESSURE ALT.	MACH NO.		APPROXIMATE VALUES						RATE OF CLIMB		
	HIGH SPEED CLIMB	COMBAT CLIMB	FROM SEA LEVEL								
			FUEL(LB)		TIME(MIN)		DISTANCE(N.M.)				
Sea Level	.92	.92	0		0		0		37,000		
5,000	.92	.92	280		.16		1.0		35,000		
10,000	.92	.92	500		.30		2.5		32,000		
15,000	.92	.92	750		.45		4.0		28,000		
20,000	.92	.92	1000		.64		5.5		24,000		
25,000	.92	.92	1200		.86		7.0		20,000		
30,000	.92	.92	1450		1.10		9.5		16,000		
30,000	-	1.5 (accel)	-	3150	-	2.7	-	30.0	-	NIL	
35,000	.92	1.5	1700	3470	1.5	3.0	12.5	33.5	11,000	14,500	
40,000	.92	1.5	2000	3750	2.0	3.2	17.0	38.0	7,000	11,500	
45,000	.92	1.5	2500	4150	3.0	3.8	26.0	46.0	3,000	6,000	
47,000	-	1.5	-	4450	-	4.2	-	51.0	-	4,000	
50,000	-	1.5	-	4950	-	5.2	-	66.0	-	1,500	
51,000	-	1.5	-	5450	-	5.9	-	76.0	-	500	
Start, Take-off and Accelerate to Climb Allowance			1643		1.39		4.47				
Data as of:		Oct. 1957 (71/PERF/3)									
Based on:		Estimated Data									
Based on:		J P 4 Fuel									
FIGURES HAVE NOT BEEN FLIGHT CHECKED											

FIG 4-4 CLIMB CHART (WITH A/B) - 60,000 LB

Indicated Maximum
Angle of Attack

- 15° (in level flight)
1/2° less for each incremental 'g' imposed.

Weights

Gross Weight Empty	-	49,000 lb (approx)
Gross Weight plus 1/2 Fuel	-	59,000 lb (approx)
Gross Weight plus Full Fuel	-	69,000 lb (approx)
Maximum Landing Weight	-	65,000 lb (approx)

*do not
exceed
model spec
2
55,000*

'G' Limits

4. 'G' limits are shown on Figs 4-12, 4-13 and 4-14.
5. The maximum load factor in a rolling pull out is 2/3 of the maximum allowable 'g' at that time.

AIRCRAFT ARROW 1		TAKE-OFF DISTANCES FEET (AT SEA LEVEL)				ENGINES J 75 - P 3	
A/C WEIGHT START OF T.O. (LB.)	STANDARD DAY 15°C A/B ON		HOT DAY 38°C A/B ON		STANDARD DAY 15°C NO A/B		
	GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'	
50,000							
55,000							
60,000							
65,000							
(70,000)							
Data as of: Oct. 1957 (71/PERF/3)							
Based on: Estimated Data							
Based on: J P 4 Fuel							
FIGURES HAVE NOT BEEN FLIGHT CHECKED							

FIG 4-1 TAKE OFF DISTANCE CHART

AIRCRAFT ARROW 1		CLIMB CHART (At 527 KTS. T.A.S.) NO AFTERBURNER			ENGINES J 75 - P 3
MILITARY THRUST - ENGINE START GROSS WT. - 60,000 LB.					
PRESSURE ALT.	TRUE A/S (KNOTS)	APPROXIMATE VALUES FROM SEA LEVEL			RATE OF CLIMB
		FUEL(LB)	TIME(MIN)	DIST.(N.M.)	
Sea Level	527	0	0	0	10,500
5,000	527	236	.48	4.3	10,050
10,000	527	471	1.02	8.8	8,850
15,000	527	706	1.63	14.2	7,550
20,000	527	940	2.32	20.4	6,200
25,000	527	1192	3.22	28.0	4,750
30,000	527	1480	4.43	38.7	3,200
35,000	527	1917	6.58	58.0	1,400
Start, Take-off and Accelerate to Climb Allowance		817	2.072	7.94	
Data as of: Oct. 1957 (71/PERF/3)					
Based on: Estimated Data					
Based on: J P 4 Fuel					
FIGURES HAVE NOT BEEN FLIGHT CHECKED					

FIG 4-2 CLIMB CHART (NO A/B) - 60,000 LB

AIRCRAFT ARROW 1		CLIMB CHART (At 527 KTS. T.A.S.) NO AFTERBURNER			ENGINES J 75 - P 3
MAXIMUM THRUST - ENGINE START GROSS WT. - 68,765 LB.					
IAS or M					
PRESSURE ALT.	TRUE A/S (KNOTS)	APPROXIMATE VALUES			RATE OF CLIMB
		FROM SEA LEVEL			
		FUEL(LB)	TIME(MIN)	DIST.(N.M.)	
Sea Level	527	0	0	0	9,100
5,000	527	273	.57	5.0	8,600
10,000	527	546	1.18	10.2	7,450
15,000	527	827	1.88	16.5	6,300
20,000	527	1108	2.74	24.0	5,100
25,000	527	1403	3.81	33.4	3,850
30,000	527	1752	5.29	46.5	2,400
35,000	527	2360	8.29	73.4	500
Start, Take- off and Accelerate to Climb Allowance		946	2.487	9.862	
Data as of: Oct. 1957 (71/PERF/3)					
Based on: Estimated Data					
Based on: J P 4 Fuel					
FIGURES HAVE NOT BEEN FLIGHT CHECKED					

FIG 4-3 CLIMB CHART (NO A/B) - 68,765 LB

AIRCRAFT ARROW 1		GROSS WT. 68 ,765 LB.		CLIMB CHART WITH AFTERBURNERS				MAX. THRUST		ENGINES J 75 - P 3	
PRESSURE ALT.	MACH NO.		APPROXIMATE VALUES						RATE OF CLIMB		
	HIGH SPEED MISSION	COMBAT CLIMB	FROM SEA LEVEL								
			FUEL(LB)		TIME(MIN)		DISTANCE(N.M.)				
Sea Level	.92	.92	0		0		0		32,000		
5,000	.92	.92	300		.15		1.5		30,500		
10,000	.92	.92	600		.35		2.5		28,000		
15,000	.92	.92	860		.50		4.5		24,800		
20,000	.92	.92	1100		.75		6.5		21,000		
25,000	.92	.92	1400		1.0		8.5		17,400		
30,000	.92	.92	1700		1.3		11.0		13,600		
30,000	-	1.5(accel)	-	3500	-	3.0	-	31.5	-	NIL	
35,000	.92	1.5	2000	3900	1.75	3.3	15.0	36.0	10,000	-	
40,000	.92	1.5	2350	4250	2.4	3.7	21.0	40.5	5,200	9,500	
45,000	.92	1.5	3100	4800	4.0	4.4	35.0	50.0	1,000	4,500	
47,000	-	1.5	-	5100	-	4.9	-	58.0	-	2,700	
49,000	-	1.5	-	5750	-	5.9	-	72.0	-	900	
Start, Take-off and Accelerate to Climb Allowance			1879		1.529		5.303				
Data as of:		Oct. 1957 (71/PERF/3)									
Based on:		Estimated Data									
Based on:		J P 4 Fuel									
FIGURES HAVE NOT BEEN FLIGHT CHECKED											

FIG 4-5 CLIMB CHART (WITH A/B) - 68,765 LB

AIRCRAFT ARROW 1		FUEL FLOW AT MACH 0.92 AND MACH 1.5 IN LB/MIN/ENGINE						ENGINES J 75 - P 3		
ALTITUDE FT.	AIRCRAFT WEIGHT LB.									
	45,000		50,000		55,000		60,000		65,000	
	Mach .92	Mach 1.5	Mach .92	Mach 1.5	Mach .92	Mach 1.5	Mach .92	Mach 1.5	Mach .92	Mach 1.5
25,000	69.2	-	72.3	-	75.5	-	79.1	-	83.3	-
30,000	62.6	-	65.9	-	70.8	-	76.9	-	82.3	-
35,000	58.0	465.0	63.1	470.0	70.0	472.0	78.6	472.0	87.9	476.0
40,000	58.0	382.0	64.5	384.0	73.9	386.4	-	386.4	-	387.8
45,000	57.7	303.5	69.2	305.5	-	307.5	-	310.5	-	316.0
Data as of:		Oct. 1957 (71/PERF/3)					Notes: (1) 45" Divergent ejector used.			
Based on:		Estimated Data					(2) Fuel Flow is increased by 5%.			
Based on:		J P 4 Fuel								
FIGURES HAVE NOT BEEN FLIGHT CHECKED										

FIG 4-6 FUEL FLOW CHART

AIRCRAFT ARROW 1		LANDING DISTANCE FEET (WITH PARABRAKE AND DIVEBRAKES)		ENGINES J 75 - P 3
GROSS WT. LB.	IAS APPROACH (E.A.S.) KNOTS	HARD SURFACE RUNWAY - NO WIND - TEMP 15°C - ENGINES IDLE AT SEA LEVEL		
		GROUND RUN	CLEAR 50'	
40,000	180			
45,000	180			
50,000	180			
55,000	180			
60,000	180			

Data as of:	Oct. 1957 (71/PERF/3)	Notes: (1)	Parabrake Fully Effective One Second After Touchdown.
Based on:	Estimated Data	(2)	Divebrakes Extended.
Based on:	J P 4 Fuel	(3)	Brakes Applied 5 Seconds After Touchdown.
		(4)	Calculated Ground Run Has Been Increased By 20%.

FIGURES HAVE NOT BEEN FLIGHT CHECKED

FIG 4-7 LANDING DISTANCE CHART

AIRCRAFT ARROW 1 <div> LANDING DISTANCE (VARIATION WITH AIRCRAFT WEIGHT & POINT OF BRAKE APPLICATION) (WITH DIVE BRAKES - NO PARABRAKE) </div>				
GROSS WT. LB:	APPROACH E.A.S. KNOTS	BRAKES APPLIED AT % OF TOUCHDOWN SPEED	HARD SURFACE RUNWAY - NO WIND - TEMP 15°C - ENGINES IDLE	
			AT SEA LEVEL	
			GROUND RUN	NUMBER OF STOPS AVAILABLE BEFORE BRAKE RENEWAL
40,000	180	90% 80% 70%		50 stops 50 Or More Stops 50 Or More Stops
47,000	180	90% 80% 70%		20 Stops 25 Stops 50 Stops
54,000	180	90% 80% 70%		2 Stops 10 Stops 25 Stops
61,000	183	90% 80% 70		1 Stop 5 Stops 20 Stops
Data as of: Oct. 1957 (71/PERF/3) Notes: (1) Length of available runway and wind strength will decide the point of brake application. Based on: Estimated Data Based on: J P 4 Fuel FIGURES HAVE NOT BEEN FLIGHT CHECKED				
			(2) The "Number Of Stops Available" is based on AVROCAN SPEC. and GOODYEAR. (3) Divebrakes Extended. (4) No Parabrake. (5) Calculated ground run has been increased by 20%.	

FIG 4-8 LANDING DISTANCE CHART

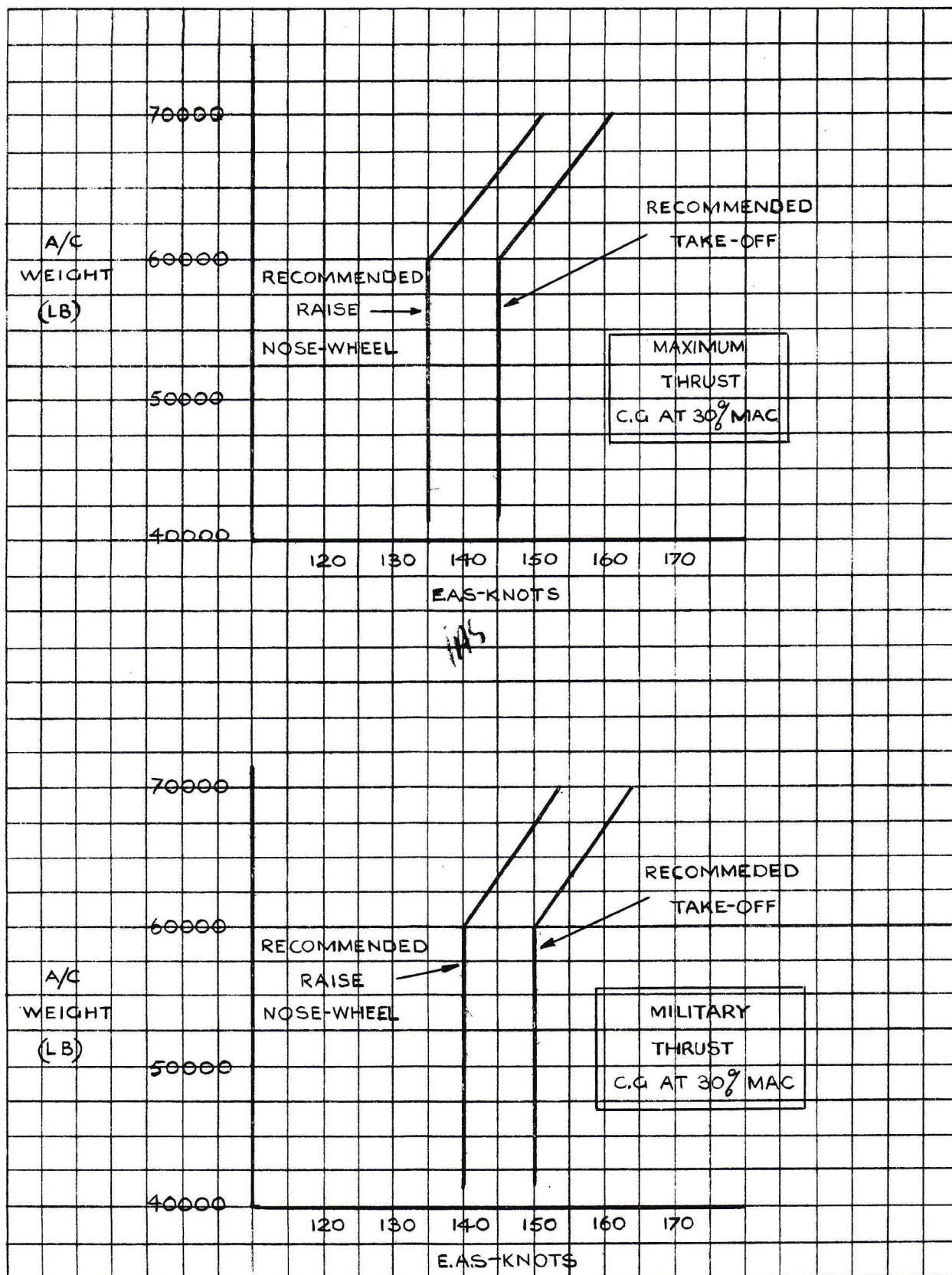


FIG 4-9 RECOMMENDED TAKE-OFF SPEEDS

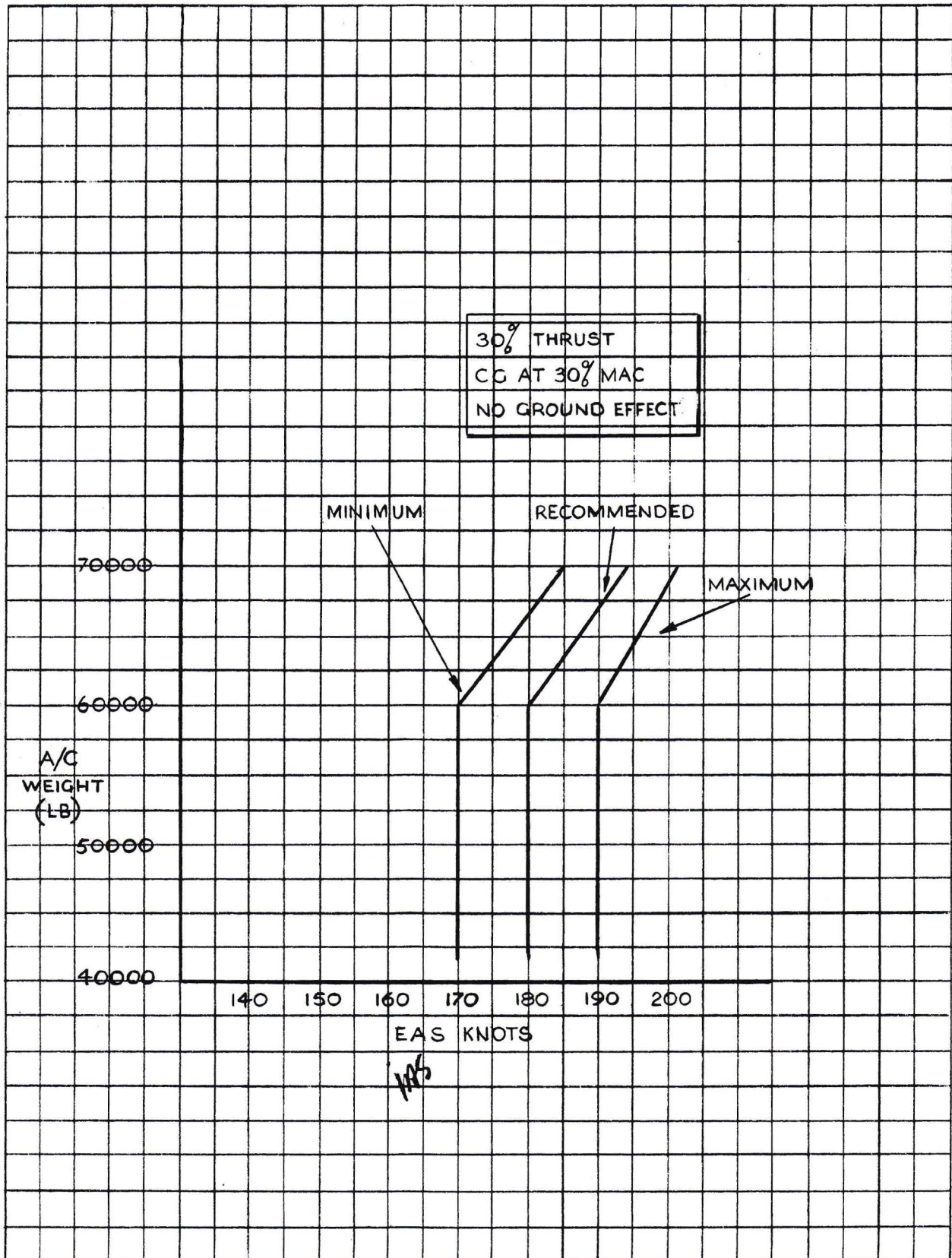


FIG 4-10 RECOMMENDED APPROACH SPEEDS

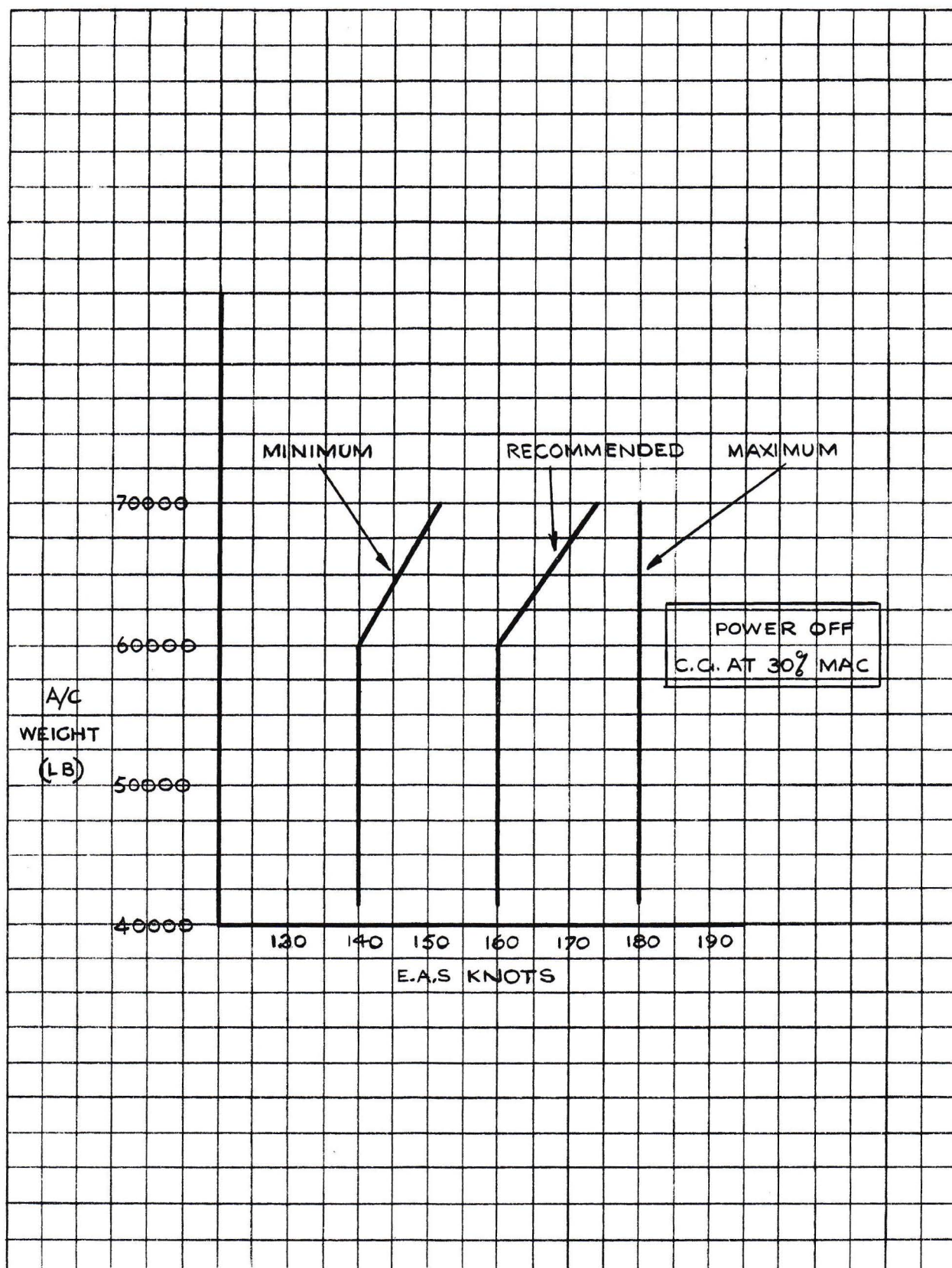


FIG 4-11 RECOMMENDED TOUCH-DOWN SPEEDS

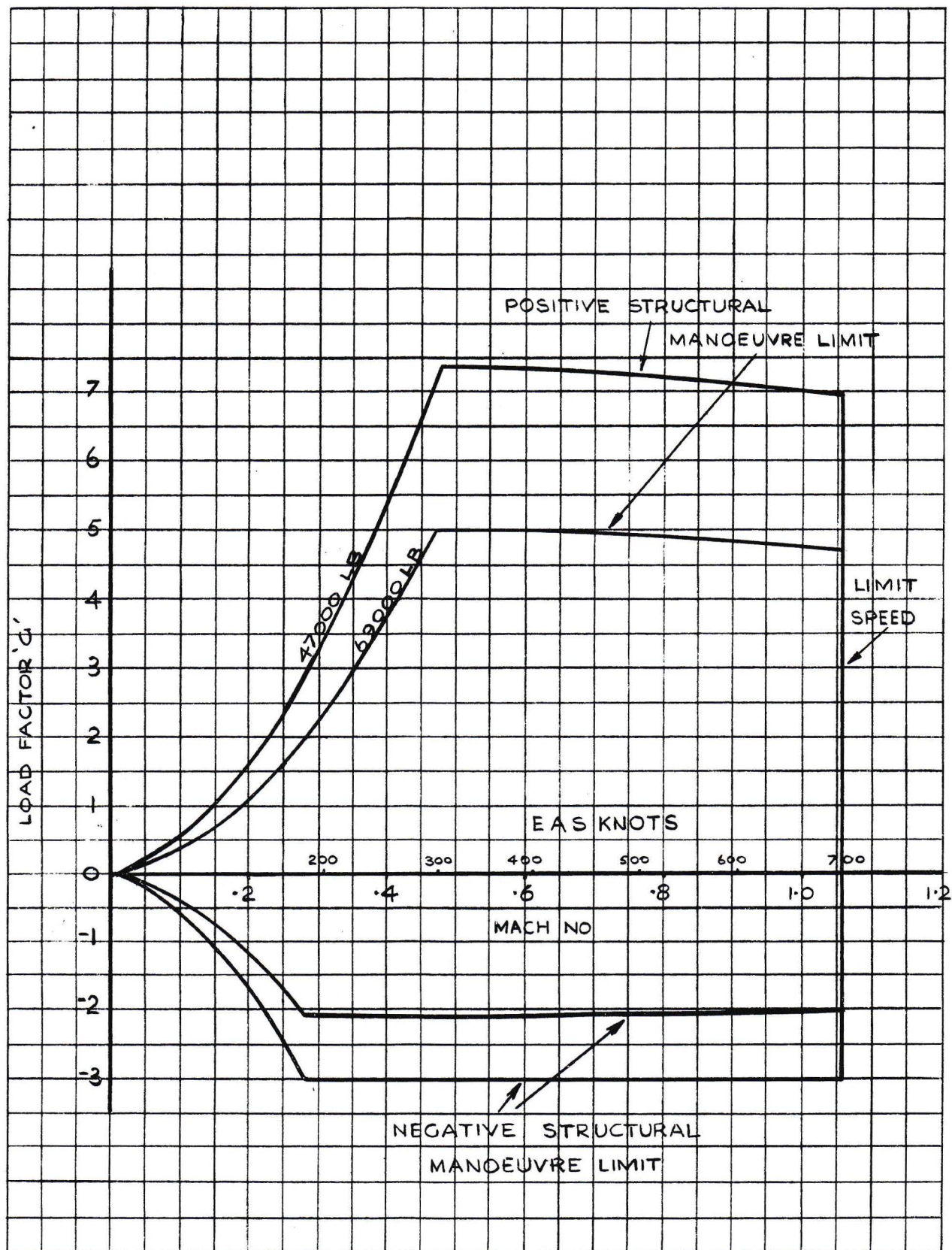


FIG 4-12 FLIGHT ENVELOPE - SEA LEVEL

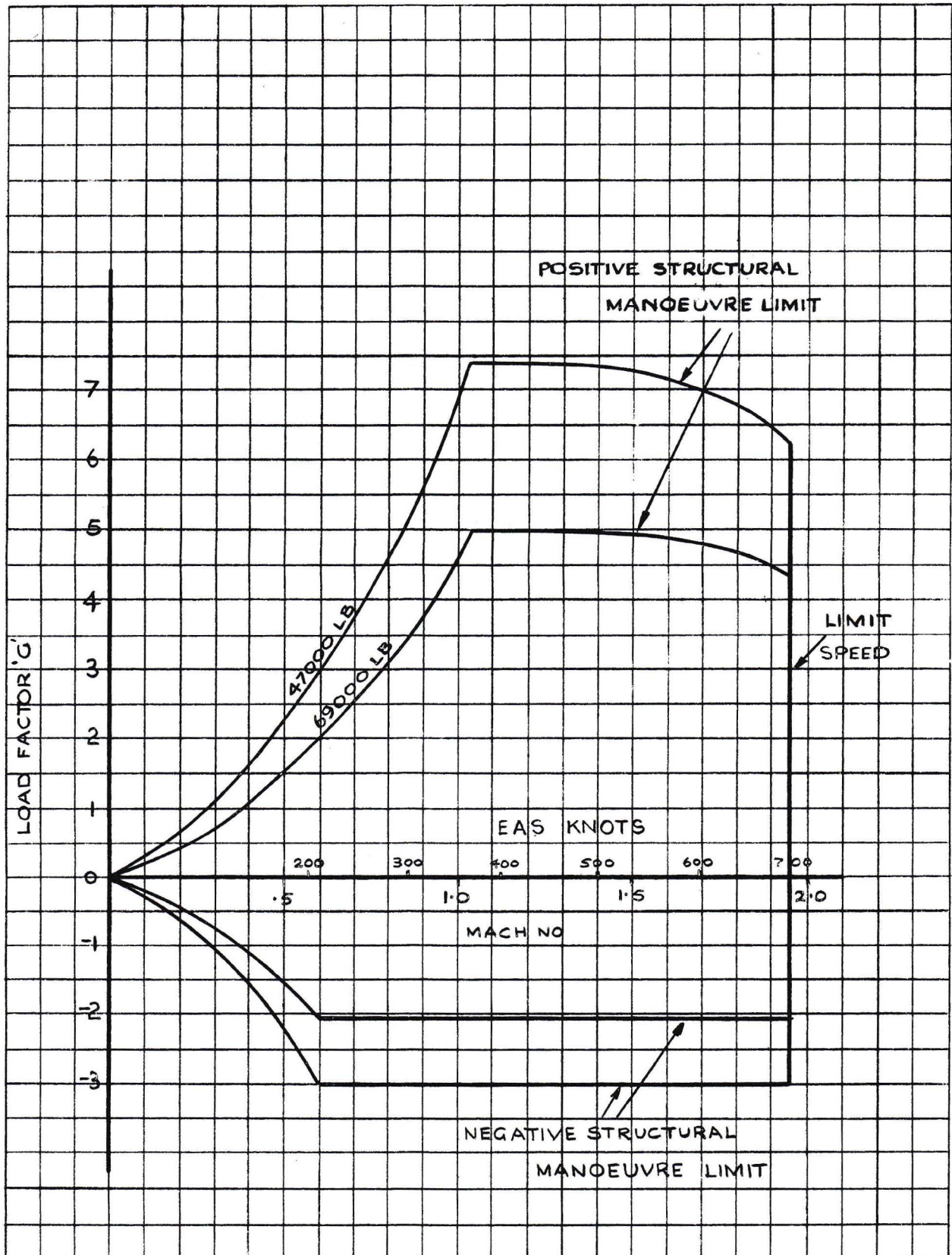


FIG -13 FLIGHT ENVELOPE - 30,000 FT

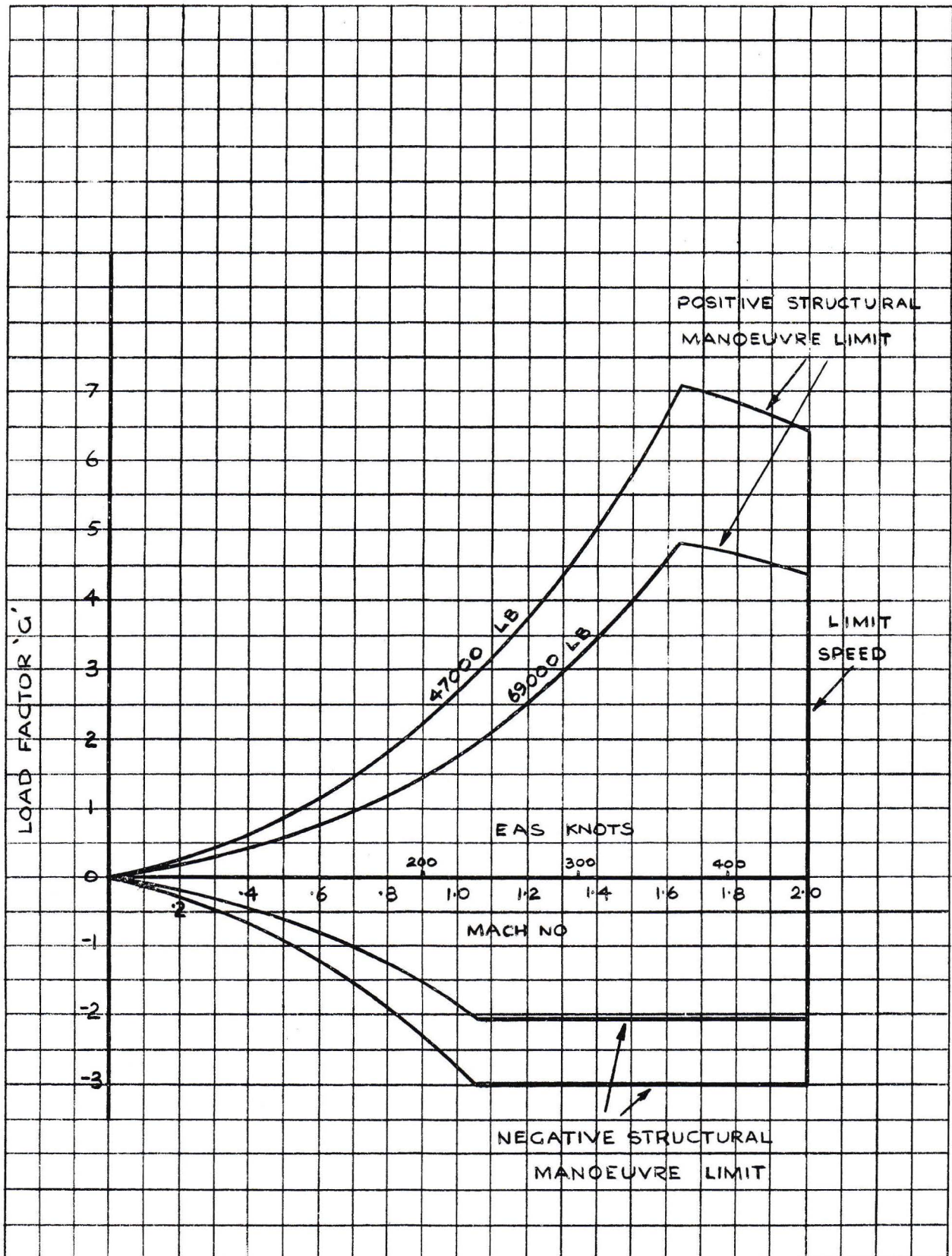


FIG 4-14 FLIGHT ENVELOPE - 50,000 FT