SECTION 6

LONG RANGE CRUISE-CLIMB PERFORMANCE

1. The cruise-climb is the optimum flight path for fuel economy. The cruise-climb requires about $2\frac{1}{2}$ per cent less fuel than a stepped cruise with 4,000 feet steps.

The chart enables the cruise fuel, time and altitudes to be obtained for an optimum four engines, long range cruise-climb at 0.84 M_{IND}. The time scale is accurate for JSA+10; for other temperatures correct time as follows:- for each 5°C hotter subtract $1\frac{1}{2}\%$; for each 5°C colder add $1\frac{1}{2}\%$.

The method of using the chart is shown by the following example

Data required

Cruise distance:	2,800 n.ms.
Mean wind component:	- 43 kts.
Start weight:	288,000 lb.
Temperature:	J.S.A. + 5°C

Method

(a) Calculate still air distance from:

$$\text{Still air distance} = \frac{\text{(Mean T.A.S.)}}{\text{(Mean T.A.S.) + Wind}} \times \text{cruise distance}$$

$$= \frac{468}{468 - 43} \times 2{,}800$$

$$= 3{,}100 \text{ n.ms.}$$

(b) Read from chart at start weight:

Distance D_1 = 1,000 n.ms.

Time T_1 = 2.08 hrs.

Altitude = 34,800 ft.

(c) Obtain end distance D_2 by adding still air distance to D_1.

i.e. 3,100 + 1,000 = 4,100 n.ms.

(d) Read from chart at end distance D_2 (4,100 n.ms.)

End weight = 207,000 lb.

T_2 = 8.68 hrs.

Altitude = 41,700 ft.

(e) Therefore cruise quantities are:

Fuel = start weight - end weight

= 288,000 - 207,100

= 80,900 lb.

Time = $T_2 - T_1$

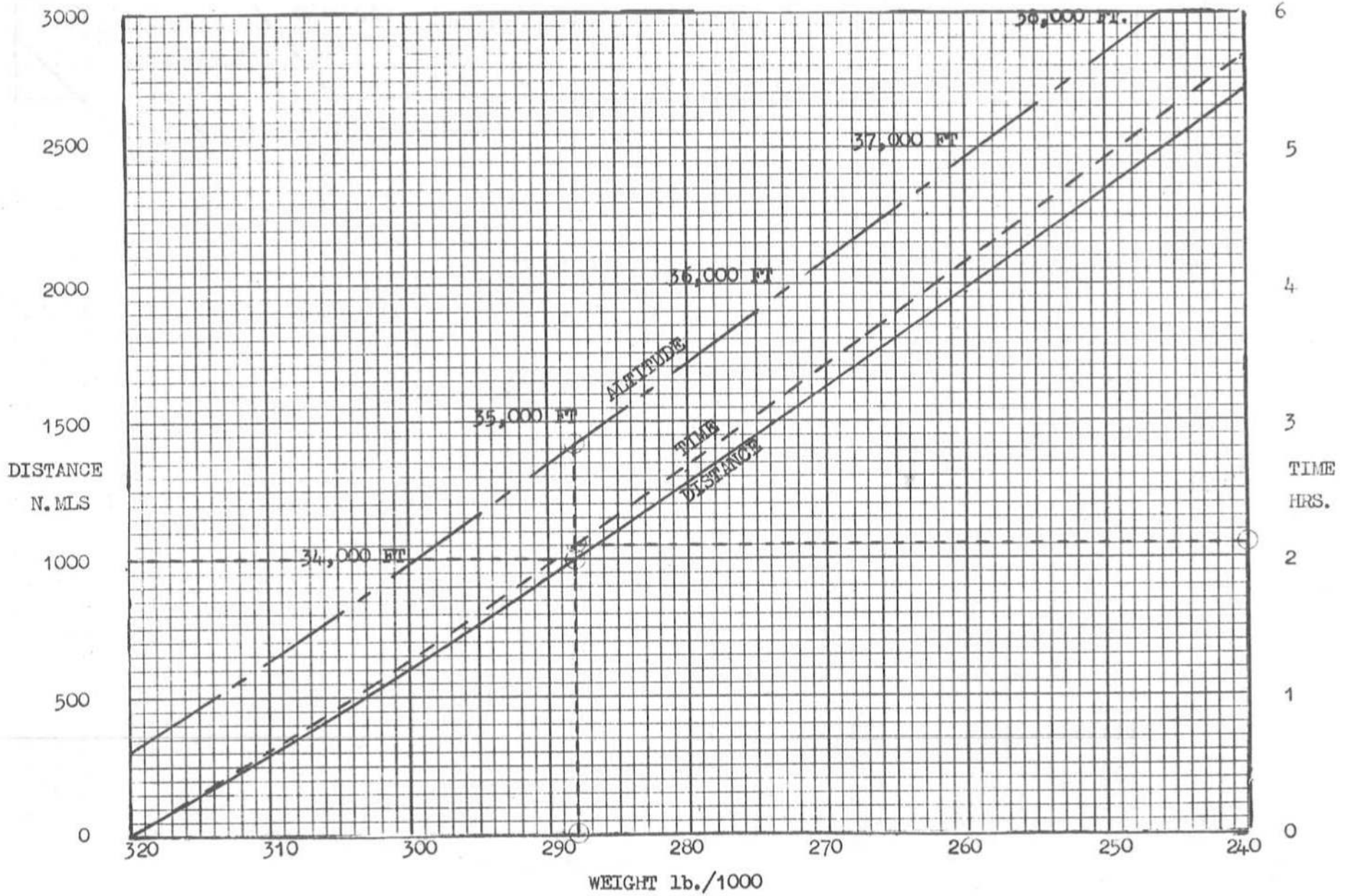
= 6.68 - 2.08

= 6.6 hrs in J.S.A. + 10°C

= 6.6 x 0.99 = 6.53 hours in J.S.A. + 5°C

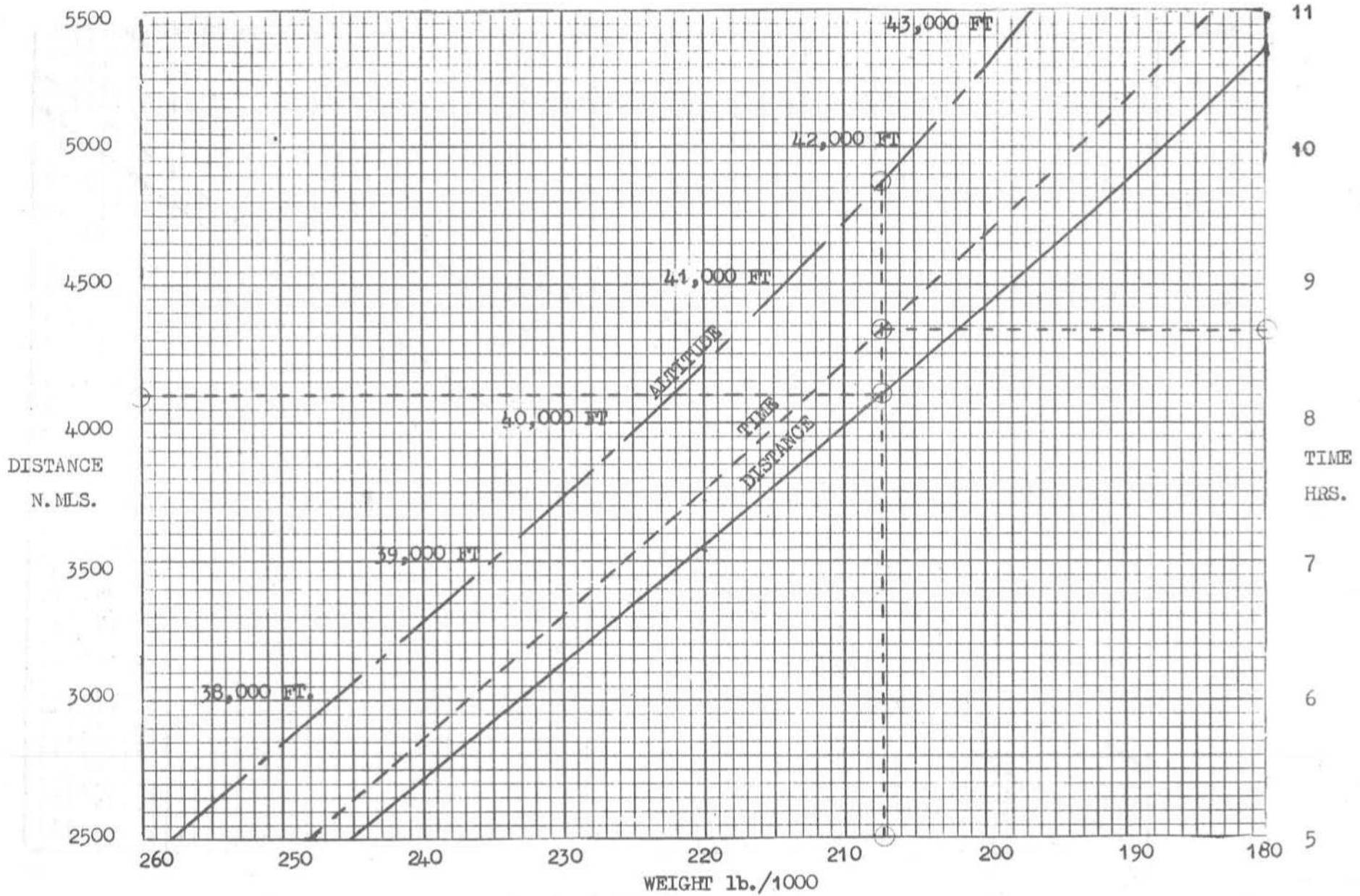
TABLE 29

LONG RANGE CRUISE CLIMB PERFORMANCE



TRUE AIR TEMPERATURE (°C)	-20	-25	-30	-35	-40	-45	-50	-55	-60	-65	-70	-75	-80
TRUE AIR SPEED (KNOTS)	505	500	495	490	485	480	474	469	463	458	452	447	440

LONG RANGE CRUISE CLIMB PERFORMANCE



TRUE AIR TEMPERATURE (°C)	-20	-25	-30	-35	-40	-45	-50	-55	-60	-65	-70	-75	-80
TRUE AIR SPEED (KNOTS)	505	500	495	490	485	480	474	469	463	458	452	447	440

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Three and two engine cruise-climb performance

With one or two engines inoperative the maximum altitude is limited by the thrust available, in most temperature conditions, to an altitude which is below the optimum for a cruise-climb. Therefore the flight path which would give the minimum fuel is at the maximum altitude possible under any given temperature conditions. These altitudes are shown on the stabilising height graphs in Sections 4 and 5. Since these altitudes are dependent on temperature it is not practicable to provide a unique chart such as that for the four-engine cruise-climb.

The flight technique when cruise-climbing on three or two engines is to maintain 300 kts. I.A.S. or 0.84 M indicated, whichever is the lesser, and 91.5% R.P.M. on all operative engines. Expected altitude, fuel flow and T.A.S. may be read from the tables.

3 ENGINE CRUISE CLIMB AT 0.84 M_{IND} /300 KTS IAS.

TEMPERATURE			INSTANTANEOUS WEIGHT lb/1000													
			310	300	290	280	270	260	250	240	230	220	210	200	190	180
JSA-10°C	HEIGHT	FT.	32000	33000	34000	35000	36000	36000	37000	37000	39000	40000	41000	42000	43000	43000
	FUEL FLOW	lb/hr.	16100	15500	15000	14500	13900	13300	12700	12200	11700	11000	10600	10000	9400	8900
	T.A.S.	KTS	465	462	460	458	456	456	454	451	449	447	445	442	440	440
JSA	HEIGHT	FT.	29000	29000	29000	31000	34000	35000	37000	38000	39000	40000	41000	42000	43000	43000
	FUEL FLOW	lb/hr.	16000	15600	15100	15400	14300	13700	13000	12400	12000	11400	10800	10300	9700	9100
	T.A.S.	KTS	450	450	450	478	471	469	465	462	460	458	456	454	451	451
JSA+10°C	HEIGHT	FT.	22000	23000	24000	26000	27000	28000	29000	31000	32000	37000	39000	41000	43000	43000
	FUEL FLOW	lb/hr.	15800	15500	15200	14900	14700	14300	14000	13800	13600	11900	11200	10500	9900	9300
	T.A.S.	KTS	414	420	426	439	446	453	460	467	474	475	471	467	462	462
JSA+20°C	HEIGHT	FT.	15000	17000	18000	19000	20000	21000	22000	23000	25000	26000	27000	27000	28000	29000
	FUEL FLOW	lb/hr.	16100	15800	15400	15100	14800	14600	14200	13900	13700	13400	13200	13000	12800	12600
	T.A.S.	KTS	380	392	397	403	409	415	422	428	441	448	455	455	462	469
JSA+30°C	HEIGHT	FT.							15000	16000	17000	18000	20000	20000	21000	21000
	FUEL FLOW	Lb/hr.							14700	14400	14200	13900	13600	13400	13100	13000
	T.A.S.	KTS							387	392	399	405	417	417	423	423

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