PART V
OPERATING DATA

102. Loading and C.G. data

(a) *C.G. limits*

(i) The C.G. limits, undercarriage down, are as follows:—

Forward limit	... ...	0.3″ aft of datum.
Aft limit	... ...	12.5″ aft of datum.

(ii) Ballast must be carried if the radar head and ranging unit are not fitted.

(iii) The aircraft is at a forward C.G. loading when fully loaded with internal fuel and ammunition.

(b) *Effects of consumption of expendable stores*

(i) *Ammunition.* Firing ammunition causes the C.G. to move aft (about 1″ per 100 rounds).

(ii) *Fuel*

Consumption of fuel from the wing tanks causes the C.G. to move slightly aft.

Consumption of fuel from the centre tanks causes the C.G. to move slightly forward. Consumption of fuel from the front tanks causes the C.G. to move progressively aft (about 2½″ per 100 gallons).

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(c) *Typical service loads*

Condition	Approx. all-up Weight (lb.)
Clean, full fuel and ammo.	17,140
With two full drop tanks	19,290
With two 1,000 lb. bombs	19,290
Clean, with 1,600 lb. fuel remaining, full ammunition	15,600

NOTE.—Full ammo.=676 lb.

103. Pressure error correction

(a) The ASI sea-level pressure error, over the speed range of the aircraft, is negligible.

(b) The following are the Machmeter pressure error corrections for all heights.

I.M.N.	0·90	0·95	0·98	1·00	1·05	1·10 and above
Correction	0	−0·01	0	+0·02	+0·05	+0·07

104. **Fuel consumptions**

The approximate fuel consumptions, in lb./minute, at various r.p.m/altitude combinations are given below.

R.p.m.	Altitude					
	Sea level	10,000′	20,000′	30,000′	40,000′	45,000′
7,000	48	40	33	26	20	16
7,250	59	48	40	31	24	20
7,500	72	59	48	36	28	24
7,750	90	75	56	40	31	25
8,000	110	85	60	43	33	26
8,600	145	95	65	47	35	27
At best range speed—clean	47 (370K)	34 (300K)	28 (280K)	23 (0.7 M)	21 (0.75M)	21 (0.8 M)
At best range speed—tanks	48 (330K)	37 (305K)	32 (290K)	29 (0·75M)	27 (0·83M)	—
At endurance speed(180-200K)	35	30	25	20	20	20

105. **Take-off distances (clean aircraft)**

The approximate take-off distances, in yards, for various wind and temperature conditions are given below.

Temperature °C.		−15	0	+15	+30	+45
Zero Wind	Ground run	480	600	720	850	1,050
	To clear 50 feet	975	1,160	1,380	1,630	1,900
30 knot Wind	Ground run	280	350	430	500	600
	To clear 50 feet	660	780	920	1,100	1,300

For every 1,000 ft. the aerodrome altitude is above sea level increase the above distances by:—

10 per cent. for ground run.

8 per cent. to clear 50 ft.

106. **Snake climbs**

For tactical snake climbs use the recommended climbing speeds and 8,400 r.p.m.

107. **Endurance**

The speed for maximum endurance varies from 180 knots at low weights to 200 knots at high weights. Para. 104 gives the appropriate fuel consumption figures.

108. **Flight planning data**

(a) *ANM/100 lb. curves*

The family of curves on page 112 shows the approximate ANM/100 lb. for various altitudes, true mach numbers, and r.p.m. settings. The horizontal curves are the ANM/100 lb. curves for the altitudes shown; the vertical dotted curves are the approximate r.p.m. settings required to achieve various true mach numbers. For heights other than those given interpolation is possible.

(b) *Flight planning data tables*

The tables preceding the ANM/100 lb. curves are based on the curves and show the flight planning data for:—

(i) *Climbing*

The climb tables give the data for climbs in I.S.A. conditions using the speeds recommended in para. 66.

(ii) *Cruising*

Each separate altitude block in the cruise tables shows:—

(1) The speed for maximum range, the approximate A.N.M.P.G. and the approximate fuel consumption for the particular height. In addition a speed band is given, use of any speed within which should not cause more than a 5% reduction in range. The height for max. range (clean) is 45,000 ft. Above this height no further range increase is possible.

(2) The range obtainable for various amounts of available fuel when flying at the best range speed for the height. The range given is to the point of let-down, allowance being made for the descent fuel required.

(3) The range obtainable for various amounts of available fuel, including the distance covered on the climb, if a climb is made to another altitude. In this case the climb must be made at the speed given in para. 66 and the flight continued at the new altitude at the best range speed for that height.

NOTE.—The range at any altitude is independent of temperature, but dependent on the weight of fuel carried.

(iii) *Descent*
The descent table gives the data for descending from one height to another.

(c) *Use of the tables*

(i) *Pre-flight planning*

Enter the cruise data table in the sea level block at the fuel state applying immediately after take-off. Select the height at which maximum range is available at that fuel state. The distance available includes distance covered on the climb, but not on the descent. (Absolute maximum range is obtained by adding on the descent distance, provided that the let-down is commenced at that distance from the destination.)
For short-range flights inspect the sea level block and select the height at which the distance to be covered requires the least amount of fuel. This is the best altitude for the flight.

(ii) *In-flight planning*

At any stage of a flight the available range may be ascertained by applying the fuel state to the level flight range in the particular altitude block.

If an increase in range is required, or if a climb has to be made, the new available range may be obtained by entering the existing altitude block at the particular fuel state and moving vertically downwards within the block until the new altitude is reached. Figures in heavy type indicate the best altitude for the maximum increase in range. Above these heights no further range increase is possible. If a descent is necessitated, the new range is shown by moving direct from the existing altitude level flight range for the particular fuel state to the new altitude level flight range.

CLEAN AIRCRAFT

FUEL CONTENTS 388 gallons
2,985 lb. NORMAL AVTAG (7.7 lb./gall.)
TAXY AND TAKE-OFF ALLOWANCE = 270 lb.
LANDING ALLOWANCE
(excluding descent fuel) = 460 lb.

CLIMB DATA

From	To	Lb.	Dist.	Mins.
Sea Level* (430K)	10,000′	390	10	2
	20,000′	510	20	3½
	30,000′	640	35	5¼
	40,000′	790	55	7¾
	45,000′	910	80	10
10,000′ (430K/0.87M)	20,000′	120	10	1½
	30,000′	250	25	3¼
	40,000′	400	45	5¾
	45,000′	520	70	8
20,000′ (0.87M)	30,000′	130	15	1¾
	40,000′	280	35	4¼
	45,000′	400	60	6½
30,000′ (0.87M)	40,000′	150	20	2½
	45,000′	270	45	4¾
40,000′ (0.87M)	45,000′	120	25	2¼

*In this block, fuel used is from start-up; times are from wheels rolling.
CLIMB AS RECOMMENDED IN PARA 66.

DESCENT DATA

From	To	Lb.	Dist.	Mins.
45,000′	30,000′	30	15	2
	20,000′	60	20	3
	10,000′	105	25	4¼
	Sea Level	185	35	6
30,000′	20,000′	30	5	1
	10,000′	75	10	2¼
	Sea Level	150	20	4
20,000′	10,000′	45	5	1¼
	Sea Level	120	15	3
10,000′	Sea Level	75	10	1¾

AIRBRAKE ... ... OUT, FLAP 20°
R.P.M. 7,000
SPEED ... ... 280K.

CRUISE DATA — CLEAN AIRCRAFT

FUEL AVAILABLE Pounds		2,750	2,500	2,000	1,500	1,000
Sea Level	Range	280	250	185	125	60
ANM/100lb —12.5 Lb/hr —2800 Best Range Speed —370K 95% RangeSpeed—260-410K	10,000′	355	315	230	145	**60**
	20,000′	450	395	280	165	50
	30,000′	530	460	325	180	35
	40,000′	585	500	330	160	—
	45,000′	**605**	**515**	**335**	**155**	—
10,000 ft.	Range	—	330	245	160	75
ANM/100lb —17 Lb/hr —2050 Best Range Speed—300K 95%RangeSpeed—240-370K	20,000′	—	415	300	185	**70**
	30,000′	—	490	345	200	55
	40,000′	—	545	375	**205**	—
	45,000′	—	**550**	**370**	190	—
20,000 ft.	Range	—	430	315	200	**85**
ANM/100lb —22·5 Lb/hr —1650 Best Range Speed—280K 95% Range Speed—200K-0.7M	30,000′	—	510	365	220	75
	40,000′	—	565	395	**225**	55
	45,000′	—	**570**	**390**	210	—
30,000 ft.	Range	—	—	390	245	**100**
ANM/100lb —29 Lb/hr —1400 Best Range Speed—0.7M 95% Range Speed—180K-0.8M	40,000′	—	—	425	**255**	85
	45,000′	—	—	**420**	240	60
40,000 ft.	Range	—	—	450	**280**	**110**
ANM/100lb —34 Lb/hr —1250 Best Range Speed—0.75M 95% Range Speed —180K-0.86M	45,000′	—	—	**445**	265	85
45,000 ft.	Range	—	—	**490**	**310**	**130**
ANM/100lb. —36 Lb/hr —1280 Best Range Speed —0.8M 95% Range Speed—180K-0.86M						
FUEL AVAILABLE Pounds		2,750	2,500	2,000	1,500	1,000

NOTE:—These figures are based on flight tests.

WITH DROP TANKS

FUEL CONTENTS:— 588 GALLONS
4,525 lb. NORMAL AVTAG (7.7 lb.gall.)

TAXY AND TAKE-OFF ALLOWANCE = 270 lb.

LANDING ALLOWANCE (excluding descent fuel) = 460 lb.

CLIMB DATA

From	To	Lb.	Dist.	Mins.
Sea Level* (430K)	10,000′	430	10	2¼
	20,000′	590	25	4
	30,000′	770	45	6¼
	40,000′	990	75	10
10,000′ (430K/0.87M)	20,000′	160	15	1¾
	30,000′	340	35	4
	40,000′	560	65	7¾
20,000′ (0.87M)	30,000′	180	20	2½
	40,000′	400	50	6
30,000′ (0.87M)	40,000′	220	30	3¾

* In this block times are from wheels rolling; fuel used includes taxy and take-off allowance.

Climb at full throttle (See para 66)

DESCENT DATA

From	To	Lb.	Dist.	Mins.
40,000′	30,000′	15	10	1
	20,000′	45	15	2
	10,000′	90	20	3¼
	Sea Level	165	30	5
30,000′	20,000′	30	5	1
	10,000′	75	10	2¼
	Sea Level	150	20	4
20,000′	10,000′	45	5	1¼
	Sea Level	120	15	3
10,000′	Sea Level	75	10	1¾

AIRBRAKES - OUT, FLAP 20°
R.P.M. - 7,000
SPEED - 280K

CRUISE DATA—WITH DROP TANKS

Fuel Available—LB.		4250	3500	3000	2500	2000	1500	1000
Sea Level	Range	425	340	290	230	175	115	**60**
ANM/100 lb.—11.5	10,000′	550	440	360	285	205	130	50
Lb./hr. —2900	20,000′	680	535	440	340	240	**140**	35
IAS—330K	30,000′	810	630	510	385	**260**	135	—
	40,000′	**905**	**700**	**555**	**410**	**260**	110	—
10,000 ft.	Range	—	450	375	300	220	145	**65**
ANM/100 lb—15.5	20,000′	—	560	465	365	265	**165**	60
Lb./hr —2250	30,000′	—	655	535	415	295	**165**	40
IAS—305K	40,000′	—	**735**	**590**	**450**	**300**	150	—
20,000 ft.								
ANM/100 lb.—20	Range	—	575	480	380	280	180	**80**
Lb./hr. —1950	30,000′	—	670	560	440	315	**190**	65
IAS—290K	40,000′	—	**760**	**625**	**480**	**335**	185	—
30,000 ft.								
ANM/100 lb.—24.5								
Lb./hr. —1750	Range	—	705	585	465	340	**215**	**90**
Speed–0.75M	40,000′	—	**790**	**650**	**510**	**365**	**215**	65
40,000 ft.								
ANM/100 lb.—28.5	Range	—	**820**	**685**	**545**	**400**	**255**	**100**
Lb./hr. —1650								
Speed–0.83M								
Fuel Available—LB.		4250	3500	3000	2500	2000	1500	1000

These figures are based on flight tests.

CLEAN AIRCRAFT