Loading limitations

21. The information in the following para. 22 to 26 assumes that the aircraft is fully equipped to the basic condition defined in Table 1 and conforms with the basic modification standard defined by para. 17 and is subject to correction in accordance with instructions contained in para. 7, 8 and 19.

Take-off

22. The following combinations of crew and ammunition load are permissible with full internal fuel load and with wing-tip tanks full or empty at take-off.

No of. crew	Ammunition load	Remarks
2	600 rounds	Ammunition may be fired off at any time after take-off
2	Nil	
1	600 rounds	Ammunition may be fired off at any time after take-off
1	Nil	

Note . . .

The addition of R.Ps. to the above will give the corresponding overload *condition. R.Ps. may be fired at any time after take-off.*

Arrested landing

23. With the permissible combinations of crew and ammunition load given in para. 22, the fuel load must be *reduced* to the values given below so that the normal arrested landing weight quoted in para. 5 is not exceeded.

No. of crew	Ammunition load	Fuel quantity remaining	
		Gall. (at 8·0 lb/gall)	Lb.
2	600 rounds	100	802
2	Nil	147	1177
1	600 rounds	123	982
1	Nil	170	1357

Note . . .

The above fuel quantities refer to aircraft in the combat role. If the rocket posts and rails are fitted (overload role less R.Ps.), the above quantities are reduced by 5 gallons and 38 lb. if Mk. 8 rails are fitted, and by 9 gallons and 71 lb. if Mk. 12, Type 1 rails are fitted.

Emergency arrested landing

24. The emergency arrested landing weight given in para. 5 will be achieved if the fuel quantities quoted in para. 23 are *increased* by 220 gall. and 1760 lb.

Runway landing (non-arrested) — normal

25. With the permissible combinations of crew and ammunition load given in para. 22, the fuel load must be *reduced* to the values given below so that the normal non-arrested landing weight quoted in para. 5 is not exceeded.

No. of crew	Ammunition load	Fuel quantity remaining			
		Combat role		Overload role	
		Gall. (at 8·0 lb/gall.)	Lb.	Gall. (at 8·0 lb/gall.)	Lb.
2	600 rounds	202	1612	99	790
2	Nil	249	1987	146	1165
1	600 rounds	224	1792	121	970
1	Nil	271	2167	168	1345

Runway landing (non-arrested) — overload

26. The maximum overload (non-arrested) landing weight quoted in para. 5 corresponds with the maximum overload take-off condition but with wing-tip tank fuel consumed or jettisoned.

Note . . .

Landings must not *be made with fuel in the wing-tip tanks, except under emergency conditions.*

GRAPHICAL PRESENTATION OF LOADING

Introduction

27. Graphical presentation of the effect on the aircraft weight and C.G. position of the addition of the load items comprising the two main roles to the basic aircraft, and the effect of the variations of these loadings given in para. 21 to 26 are shown in fig. 4 and 5. These diagrams are simply a step-by-step plotting of the aircraft weight and moment as items are added to the basic aircraft condition. In each diagram, the aircraft weight is indicated by the vertical scale and the total aircraft moment (about the datum) by the horizontal scale; thus it is possible to represent both the weight and moment for any loaded condition by a single point on the diagram. Since any simultaneous weight and moment condition represents a particular C.G. position at that weight, it is possible to draw a line such that the C.G. position given by dividing the moment by the weight at any point on the line is a constant. The forward and aft C.G. limits are shown on the diagrams in this manner by continuous heavy lines, intermediate lines of "constant C.G. position" being shown for reference by chain dotted lines at 0·05 ft. intervals.

28. In order to simplify the diagrams as much as possible, only two main conditions are given:—

(*a*) Loading which gives the most forward possible C.G. positions (this loading is also the maximum all-up weight condition).

(*b*) Loading which gives the most aft C.G. positions.

In each diagram, the appropriate aircraft basic weight as given in Table 2 or 3 has been used; the effect of modifications and equipment other than those included in the basic weight has not been taken into account. If it is desired to show the effect of modifications and/or equipment changes, it is only necessary to assess the total weight and moment of such changes and apply these total differences to the salient points on the appropriate diagram.

Combat role (*fig.* 4)

29. Curve 1 shows the loading combination which gives the most forward possible C.G. for this role, i.e., two crew and full ammunition. This condition also gives the maximum possible take-off weight.

Curve 2 shows the loading combination which gives the most aft possible C.G. for this role, i.e., two crew, no ammunition.

Overload role (*fig.* 5)

30. Curve 1 shows the same condition as curve 1 in fig. 4, but with 8 × 60 lb. hd. R.Ps. on Mk. 8 rails added.

Curve 2 is as curve 2 in fig. 4, but with 12 × 12 lb. hd. R.Ps. on Mk. 12 rails added.

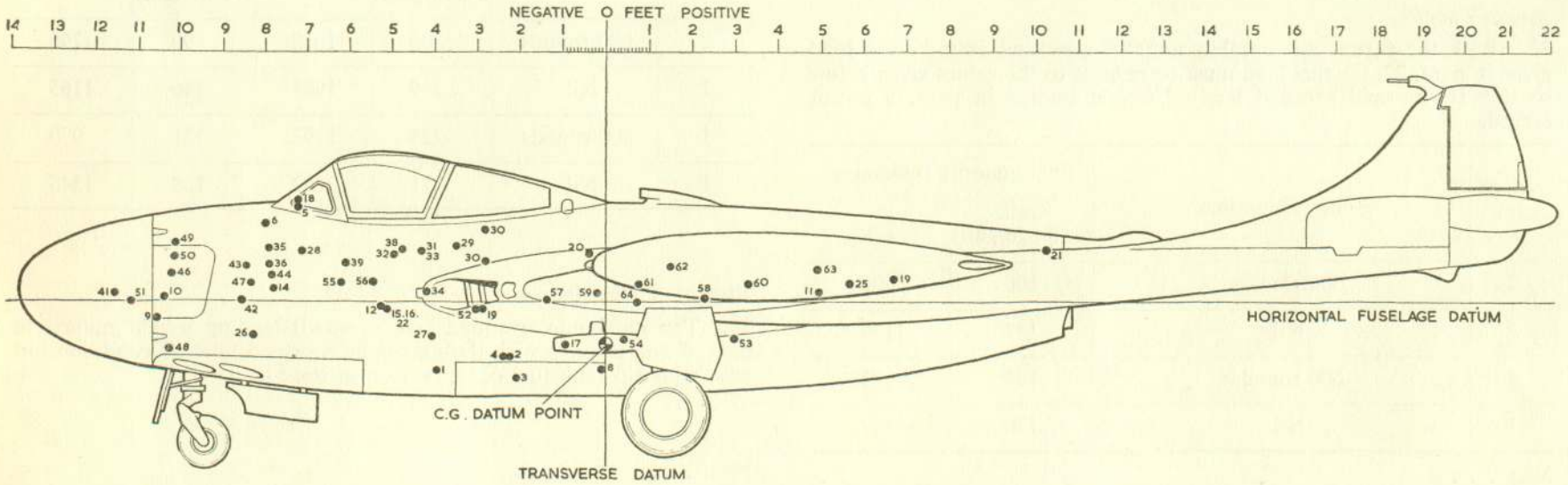

Fig. 1. Loading and C.G. diagram

TABLE 1

Major items of equipment

Item	Ref. No.	Description	No. off	Weight (lb.)	Arm (ft.)	Moment (lb.ft.)
		ARMAMENT				
1*	7G/1034	Guns, Hispano, 20 mm., aircraft No. 3, Mk. 5	4	346·0	— 3·89	—1346
*	7G/1181–2	(Including rack operating lever				
*	7G/1024	and buffer unit)				
2	7G/924–25	Belt feed mechanism, Mk. 5	4	54·0	— 2·20	— 119
3*	5D/1737	Firing unit, Maxiflux, No. 2	4	16·5	— 2·10	— 35
4*	8A/2355	Solenoid gun safety, Mk. 2	4	3·0	— 2·30	— 7
5	8B/3585	Gunsight, G.G.S., Mk. 5A	1	9·8	— 7·07	— 69
6	8B/3363	Retractable mounting, Type 7 Mk. 5	1	17·3	— 8·00	— 138
7	8B/3103	Control unit, Type AL, Mk.1	8	11·0	— 8·30	— 91
	8B/2968	Control unit, Type B, Mk. 11				
	8B/2971	Control unit, Type BL, Mk. 1				
	8B/2975	Control unit, Type RA, Mk. 1				
	8B/3339	Control unit, Type RM, Mk. 1				
	8B/3338	Control unit, Type TI, Mk. 3				
	8B/2981	Control unit, Type TB, Mk. 1				
	8B/3102	Control unit, Type S, Mk. 7				
		ELECTRICAL				
8	—	Inverter, Jack and Heintz, Type F.46	1	54·0	— 0·29	— 16
9*	5UD/6205	Blower, Type 2/PL/81H (for item No. 46)	1	0·8	—10·33	— 8
10*	5UD/6204	Blower, Type 3PL/181H (for item No. 50)	1	0·8	—10·46	— 8
11	5CX/1515	Landing lamp, Type J ...	1	5·0	+ 1·20	+ 6
12*	5A/3391	Torch, Type O	2	1·5	— 5·10	— 8
		INSTRUMENT				
14	6A/3849	Artificial horizon, Mk. 3C	1	5·7	— 7·80	— 44
15*	6B/2742	Chart board, Type F ...	1	4·4	— 5·00	— 22
16*	—	Observer's instruments ...	1 Set	1·0	— 5·00	— 5
17	14A/1380	Camera, G.45B, Mk. 3 ...	1	5·0	— ·53	— 3
18*	14A/4196	G.G.S. recorder, Mk. 3 and accessories	1	2·2	— 7·07	— 16
19	—	Oxygen charge (pre-Mod. N.901)	—	4·7	— 2·92	— 14
		Oxygen charge (post-Mod. N.901)	—	8·5	—	+ 11
		MISCELLANEOUS				
20	27UA/579	Cold air unit, A.C.R.E.9, Mk. 6EA	1	11·3	— 0·30	— 3
21	26DV/	A-frame and arrester hook assembly	1	73·3	+10·75	+ 788
		A-frame and arrester hook assembly (pre-Mod. N.877 Pt. C)	1	50·0	+11·00	+ 550
22*		Books and charts	—	2·0	— 5·00	— 10
23	27L/50043	Martin Baker lightweight ejection seat, Mk. 4A2 (Observer) (MBEU/346/S.V.) complete with gun etc.	1	80·75	— 4·72	— 381
24	15A/776	Observer's parachute (B/MBEU/473/S.V.) complete with harness	1	25·75	— 4·27	— 110
56	27C/2372	Observer's survival pack, Type N (including Dinghy, Type K, Mk. 2 (Ref. No. 27C/1927))	1	20·0	— 5·45	— 109
56	6D/1646	Observer's emergency oxygen set, Mk.4A (Mod. Inst. G.13)	1	3·0	— 5·45	— 16
25	—	Starter cartridges in flap shroud	4	16·50	+ 5·70	+ 94
		RADIO A.1961 (I/C)				
26	IOU/19596	Amplifier, Type A1961 ...	1	6·3	— 8·20	— 52
27	10D/17805	Junction Box, Type 154 ...	1	1·7	— 4·08	— 7
		A.R.I.5491 (V.H.F.)				
28	10L/247	Control unit, Type 383 ...	1	1·8	— 7·04	— 13
29	10F/16798	Relay unit, Type 123 ...	1	5·0	— 3·50	— 18
30	10D/17693–94	Trans.-Recr., Type T.R. 1934/5	2	54·0	— 2·80	— 151
		A.R.I.5307 (Z.B.X.)				
31	10D/2654	Receiver, Type R.1585 ...	1	6·4	— 4·33	— 28
32	10L/204	Control unit, Type 345 ...	1	0·9	— 4·92	— 4
33	110K/457	Dynamotor DY–2/ARR–2 ...	1	3·0	— 4·33	— 13
		A.R.I.5284 (A.Y.F.)				
34	110DB/25	Trans.-Recr., Type RT. 7/APM–1	1	18·5	— 4·24	— 78
35	110QB/6	Indicator, Type 1D–14/APN–1	1	1·8	— 7·85	— 14
36	10A/17724	Filter, Type 51	1	0·1	— 7·85	— 1
		A.R.I.5848 (I.F.F. Mk. 10)				
37	R16C–34555–500 16K–1660–211–944740	Control unit, Type C.544/APX6 or ... ... Type C.629/APX6	1	1·5	— 4·50	— 7

TABLE 1—*continued*

Item	Ref. No.	Description	No. off	Weight (lb.)	Arm (ft.)	Moment (lb.ft.)
38*	—	Recr.-Trans., Type RT.82/APX6	1	38·4	— 4·77	— 183
39*	—	Coder unit } When Mod.	1	8·9	— 6·15	— 55
40		Control unit } N.851 is embodied	1	2·0	— 5·60	— 11
		A.R.I.5860 (A.I. Mk. 21)				
41*	R16AN–AS–596 + GB1/APQ43	Antenna, Type AS.596 + GB1/APQ.43	1	131·0	—11·50	—1507
42*	R16–WX–7620821–G3	Blower, air, Type HD.133A (for item 47)	1	1·3	— 8·30	— 11
43	R16C–11688–500	Capacitor assembly, Type CB.2/APQ.35	1	4·0	— 8·37	— 35
44*	R16AN–C–1035+GB1/APQ.43	Control indicator, Type C1035/APQ.43	1	80·0	— 7·82	— 626
45	26DV/12885	Visor, Type Assy. Drg. No. 12–3F–1535A	1	2·3	— 6·20	— 14
46*	R16AN–MD–175+ GB1/APQ43	Modulator, Type MD–175+ GB1/APQ43	1	73·3	—10·16	— 745
	or	or				
	R16AN–MD–175A/APQ.43	Type MD–175A/APQ.43				

Item	Ref. No.	Description	No. off	Weight (lb.)	Arm (ft.)	Moment (lb.ft)
47*	R16AN–PP784+ GB1/APQ.43	Power unit, Type PP–784+ GB1/APQ.43	1	33·4	— 8·33	— 278
48*	10Q/16207	Strobe unit, Type 103 ...	1	5·5	—10·20	— 56
49*	R16AN–SN–103+ GB1/APQ43	Synchroniser Type SN–103+GB1/APQ.43 ...	1	38·5	—10·03	— 386
	or	or				
	R16AN–SN–103A–APQ43	Type SN–103A/APQ.43				
50*	R16AN–RT–258+ GB1/APQ43	Trans-Recr., Type R.T. 258+ GB1/APQ.43	1	64·5	—10·05	— 648
51*	R16AN–CG–1003/APQ.43	Wave guides Type CG–1003/APQ.43				
	R16AN–CU–338/AP	Directional coupler	1	4·0	—11·10	— 44
	10B/17421	Wave guide tube				

Table 2

Service loads — post-Mod. N.833

Note ref.	Item no.	Items of removable load	No. off	Normal role Day/Night combat			Overload role intruder		
				Weight (lb.)	Arm (ft.)	Moment (lb.ft.)	Weight (lb.)	Arm (ft.)	Moment (lb.ft.)
	52	Ammunition, 20 mm. Hispano	600	375	—3·00	— 1125	375	—3·00	— 1125
1	53	Projectors, rocket Mk. 8, Type 28	4	—	—	—	38	+2·92	+ 111
1	54	Projectile rocket — 60 lb. head	8	—	—	—	784	+0·40	+ 314
2	55	Pilot	1	180	—6·10	— 1098	180	—6·10	— 1098
2	56	Observer	1	180	—5·45	— 981	180	—5·45	— 981
		TOTAL ROLE EQUIPMENT PLUS CREW		735		— 3204	1557		— 2779
		Fuel at 8·0 lb/gall.							
	57	Fuselage tank 90 gall.		720	—1·30	— 936			
	58	Wing tanks No. 1 108 gall.		864	+2·30	+ 1987	(As for combat role)		
	59	Wing tanks No. 2 54 gall.		432	—0·20	— 86			
	60	Wing tanks No. 3 37 gall.		296	+3·30	+ 977			
	61	Wing tanks No. 4 17 gall.		136	+0·75	+ 102			
		TOTAL INTERNAL FUEL 306 gall.		2448	—	+ 2044	2448	—	+ 2044
	62	Wing-tip tank forward compartment 74 gall.		592	+1·51	+ 894	(As for Combat Role)		
	63	Wing-tip tank aft compartment 76 gall.		608	+4·96	+ 3016			
		WING-TIP TANK FUEL 150 gall.		1200		+ 3910	1200		+ 3910
		TOTAL ROLE EQUIPMENT PLUS CREW AND FUEL		4383		+ 2750	5205		+ 3175
	64	BASIC WEIGHT, EJECTION SEAT AIRCRAFT		10853	+0·71	+ 7701	10853	+0·71	+ 7701
		ALL-UP WEIGHT EJECTION SEAT AIRCRAFT (POST-MOD. N833)		15236	+0·686	+10451	16058	+0·677	+10876

Notes . . .

(1) Refer to Table 4 for details of alternative R.P. loadings

(2) Crew weight of 180 lb. is net

Parachute pack	26 lb.
Survival pack	20 lb.
Emergency oxygen	3 lb.
Total	49 lb. per crew is included in Basic Weight

		Weight (lb.)	Moment (lb.ft.)
Basic aircraft (from Table 2)		10853	+ 7701
Deduct:—	"Service fit" equipment (marked * in Table 1)	— 902	+ 6068
Deduct:—	Observer's parachute, etc. (included in basic weight)	— 49	+235
Add:—	Total ballast (from Table 5)	+ 860	— 6166
Add:—	Pilot (*parachute etc. is included in basic weight*)	+ 180	— 1098
Add:—	Internal fuel (from Table 2)	+ 2448	+ 2044
Add:—	Tip tank fuel	+ 1200	+ 3910
	TOTALS	14590	+12694

C.G. position $= \frac{+12694}{14590} = +0{\cdot}870$ ft., i.e., within the aft C.G. limit (tip tanks full) quoted in para. 4.

3. The delivery condition for aircraft to pre-Mod. N.833 standard is determined as follows:—

		Weight (lb.)	Moment (lb.ft.)
Basic aircraft (from Table 3)		10836	+ 7669
Deduct:—	"Service fit" equipment (marked * in Table 1)	— 902	+ 6068
Deduct:—	Observer's parachute, etc. (included in basic weight)	— 49	+ 235
Add:—	Total ballast (from Table 5)	+ 860	— 6166
Add:—	Pilot (*parachute, etc. is included in basic weight*)	+ 180	— 1098
Add:—	Internal fuel (from Table 3)	+ 2488	+ 2111
Add:—	Tip tank fuel	+ 1200	+ 3910
	TOTALS	14613	+12729

C.G. position $= \frac{+12729}{14613} = +0{\cdot}871$ ft., i.e., within the aft C.G. limit (tip tanks full) quoted in para. 4.

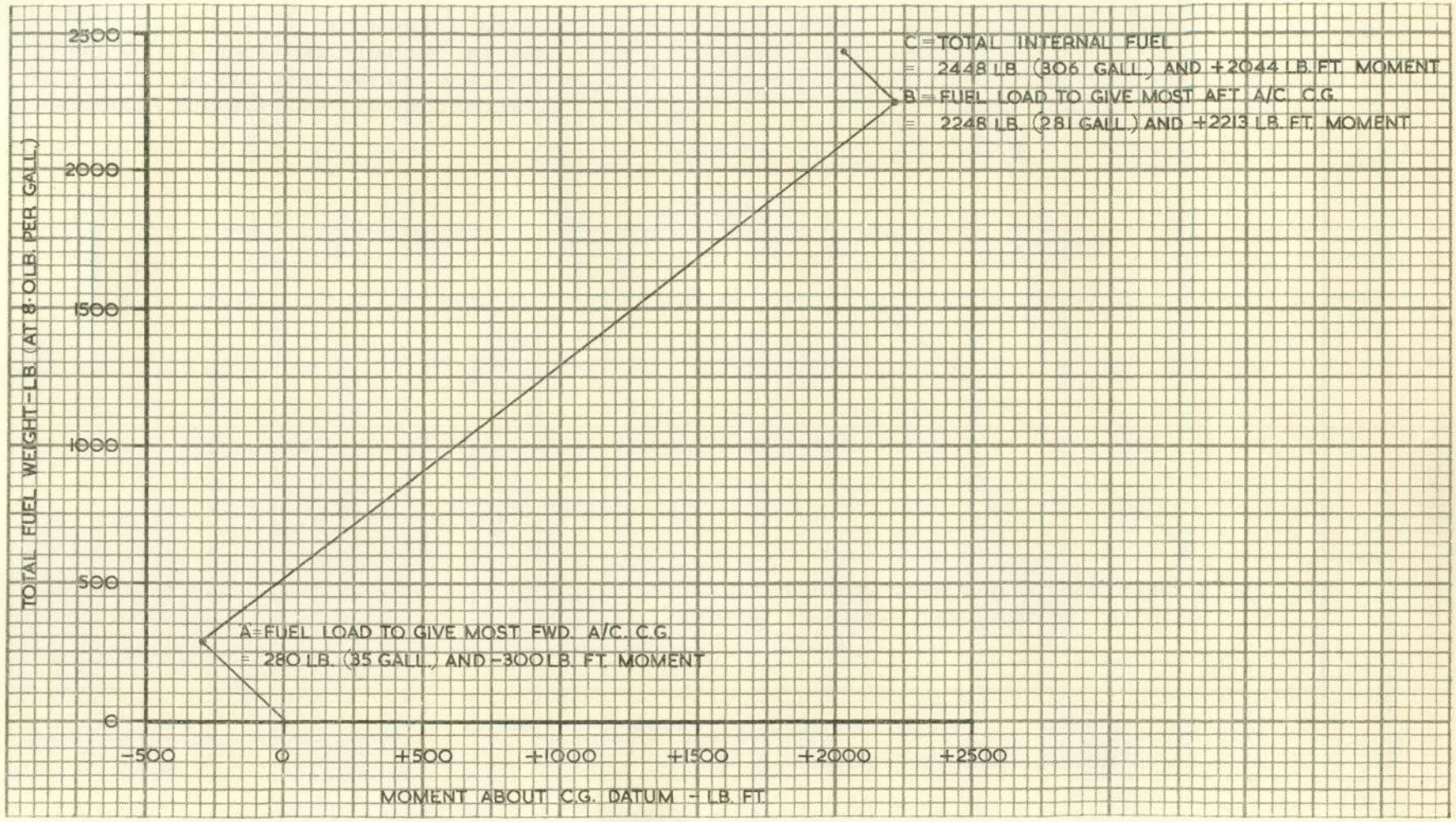

Fig. 2. Internal fuel weight/moment curve (post-Mod. N.833)

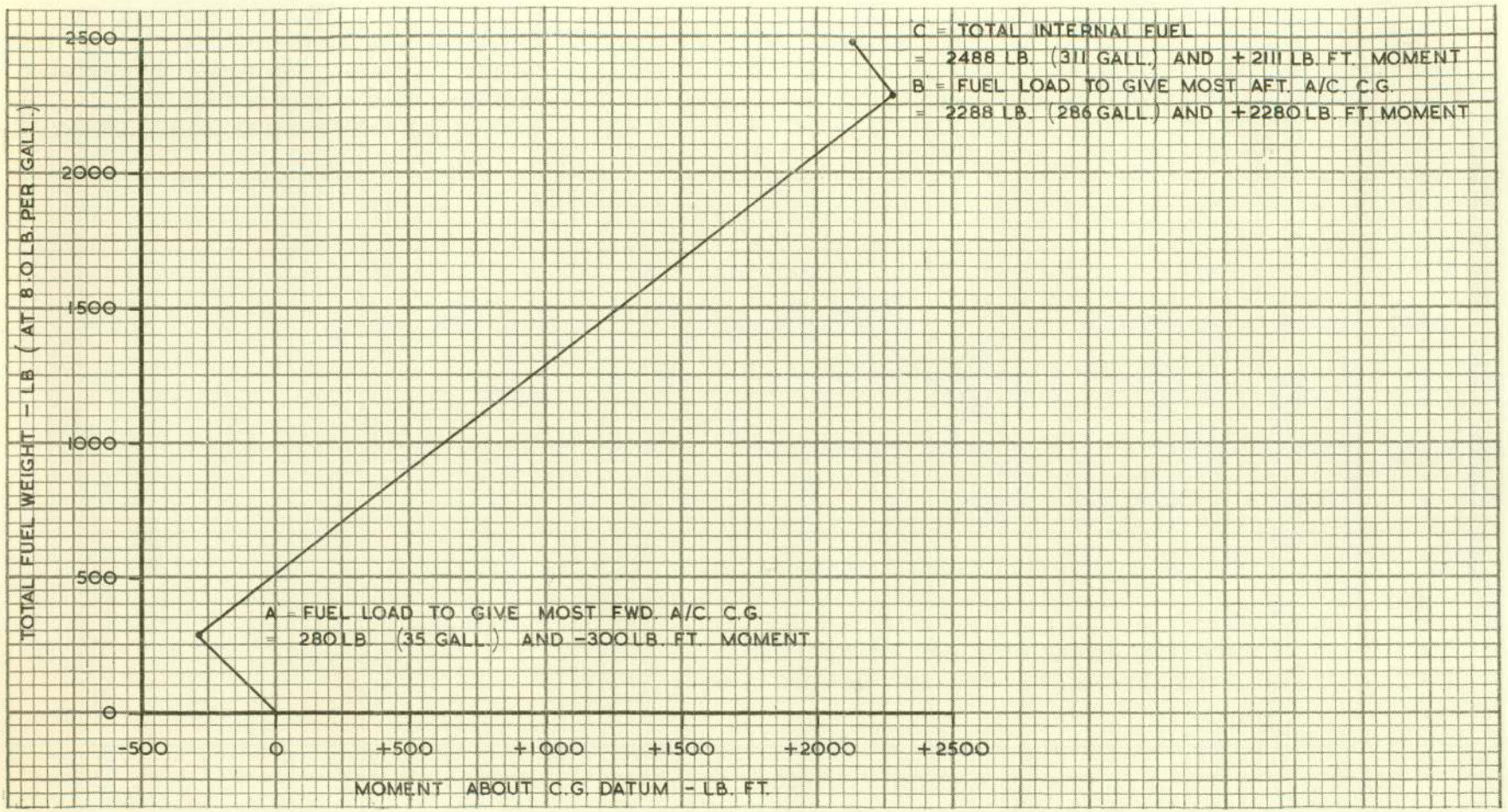

Fig. 3. Internal fuel weight/moment curve (pre-Mod. N833)

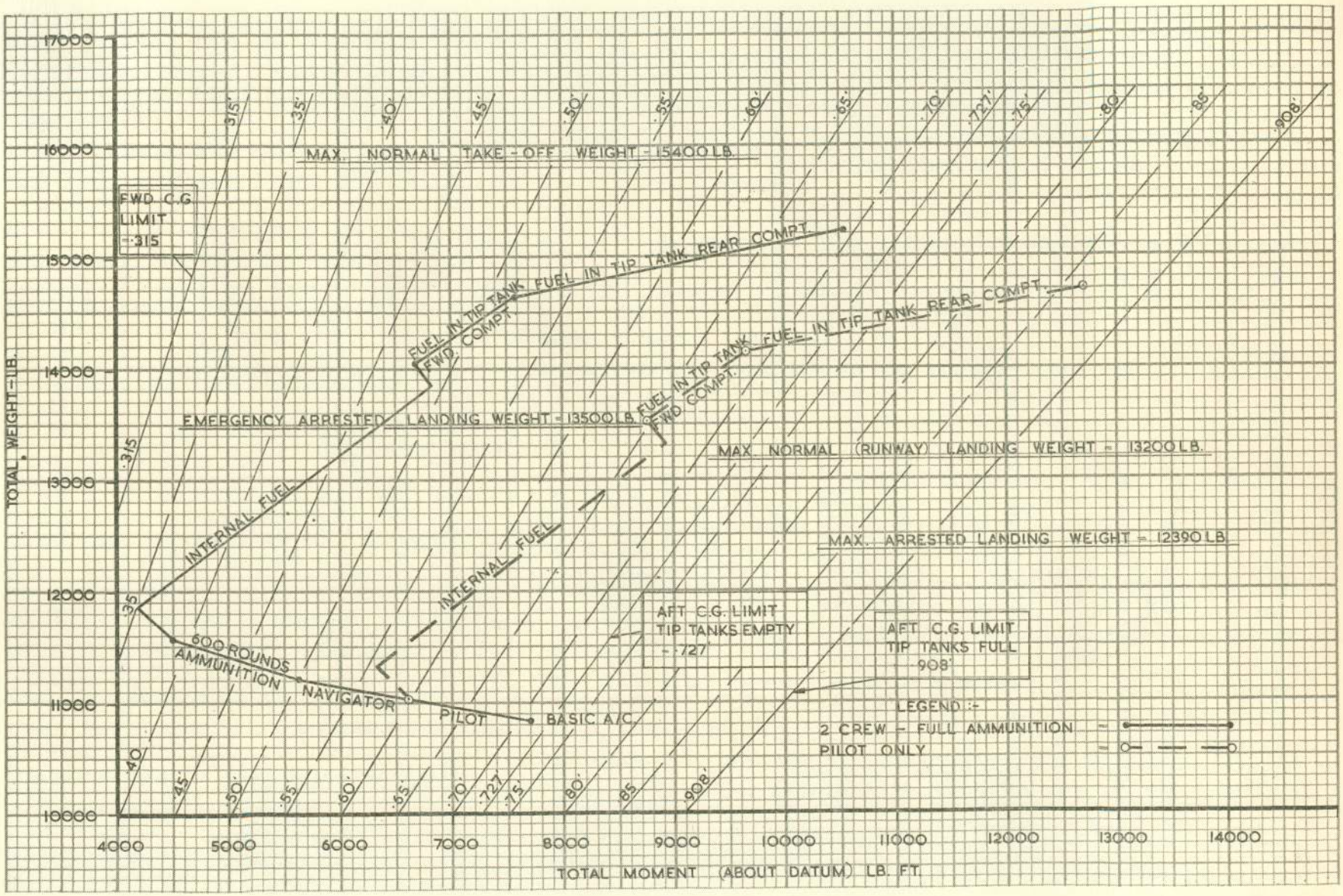

Fig. 4. Weight/moment diagram — combat role

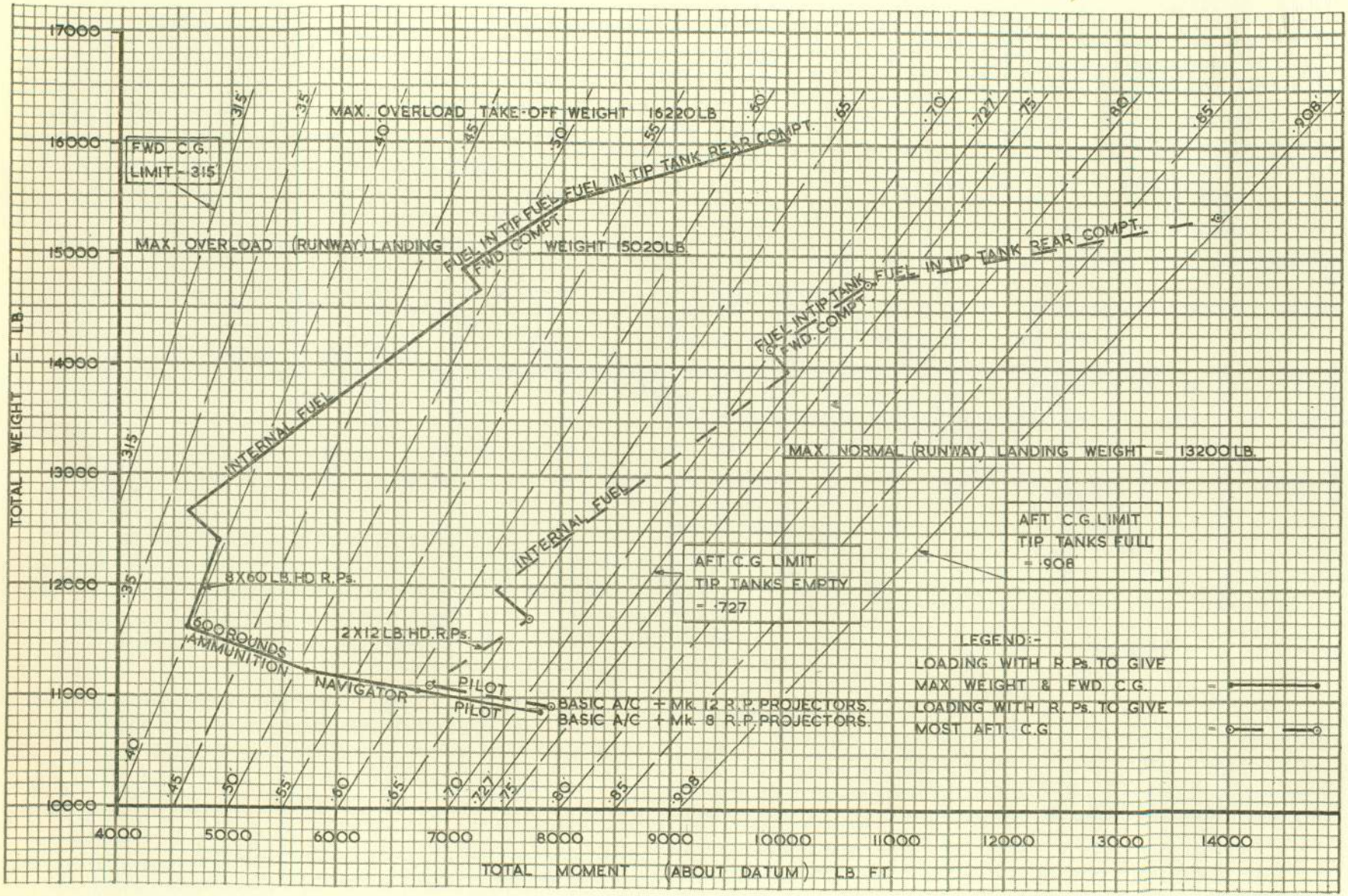

Fig. 5. Weight/moment diagram — overload role

P29849 449814/7544 2/60 625 C & P Gp 375