Chapter 3 LOADING AND C.G. DATA

(*Completely revised*)

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Introduction

1. These loading and C.G. data give general limitations applicable to the Sea Vampire T Mk.22 aircraft, irrespective of the modification standard and the number of guns fitted, but as fixed provision is made for the fitment of two or four guns, loading data relevant to these aircraft are given in the Appendices 1 and 2, respectively, to this Chapter.

Note . . .

The following fuels are cleared for use in the aircraft:—

Fuel	*Density* (*lb./gall.*)
AVTAG	7·7
AVTUR	8·0
AVCAT	8·3

The fuel weights given in fig. 2 *refer to* AVTUR. *and must be adjusted when another fuel is used.*

GENERAL INFORMATION AND LIMITATIONS

C.G. position

2. The C.G. position is determined with the aircraft in the rigging position (i.e., with the fuselage datum line horizontal and the undercarriage down), and is defined by its distance, measured parallel to the fuselage datum, from the C.G. datum point. This distance is known as the " moment arm " of the C.G. and is given by the following expression:—

$$\frac{\text{(Tare weight} \times \text{tare C.G. arm)} + \text{(loads} \times \text{respective arms)}}{\text{Tare weight} + \text{total weight of loads}}$$

$$\frac{\text{Tare moment} + \text{load moments}}{\text{Total weight}}$$

All moment arms are measured in feet and are positive when they refer to items aft of the C.G. datum and negative when they refer to items forward of this datum.

C.G. datum point

3. The position of the C.G. datum point is indicated by a peg on the port side of the fuselage. This peg is located at the intersection of a line (normal to the fuselage datum) through the lower wing/fuselage attachment fitting (transverse datum), with a line parallel to and 15 inches below the fuselage datum line.

Permissible limits of C.G. travel

4. The approved limits of C.G. travel, with the undercarriage down, are as follows:—

Forward limit	—0·270 feet (0·167 S.M.C.)
Aft limit	+0·367 feet (0·260 S.M.C.)

For ferrying only, the aft limit is extended as follows:—

Aft limit	+0·401 feet (0·265 S.M.C.)

Note . . .

Refer to Pilot's Notes for restrictions pertinent to ferrying conditions.

The aircraft C.G. must be kept within the above limits even when load or fuel are wholly or partially expended.

Maximum permissible all-up weight

5. The weight limitations applicable to aircraft covered by these loading data are:—

Take-off

(1) All forms of flying (clean aircraft or with eight R.Ps. only) 11 860 lb.

(2) Speed restricted (with bombs) 13 290 lb.

(3) Gentle manoeuvres (with drop tanks) 13 610 lb.

Note . . .

It is an over-ruling requirement that the all-up weight, less the weight of the bombs and carriers or drop tanks and their fuel, must not exceed 11 860 *lbs.*

Landing

(1) Normal (clean aircraft or with external stores including empty drop tanks) 13 290 lb.

(2) Emergency 13 480 lb.

Note . . .

Refer to Pilot's Notes for speed, manoeuvre and emergency landing restrictions.

Modification standard

6. The basic modification standard is listed below, and includes all modifications which have negligible effects on the aircraft weight and/or C.G. position.

Airframe:—

50, 72, 77, 86, 90, 100, 108, 112–114, 118, 124, 138, 139, 142, 146, 154, 158, 177, 183, 205, 206, 220, 222, 228, 239, 246, 251, 253, 254, 259, 265, 267, 270, 272, 273, 275–277, 295, 297, 307, 310, 312, 314, 317, 319, 339, 356, 359, 361, 363, 364, 369, 383, 384, 389-391, 397, 398, 402, 411, 413, 415, 425, 426, 429, 442, 492, 493, 498, 500, 520, 529, 542, 543, 545, 589, 591, 604, 607, 612, 614, 615, 622, 625, 626, 652, 654, 656–658, 664, 666, 669, 676, 682, 688, 692, 694, 696, 698, 720, 722, 728, 737, 739, 764, 766, 767, 769, 785–787, 791, 805, 806, 809, 810, 812, 815, 816, 818, 840, 842, 844, 846, 871, 880, 882, 884, 899, 910, 921, 923, 926, 930, 932, 934, 936, 947, 950, 960, 964, 967, 978, 980, 983, 996, 997, 1057, 1058, 1059, 1060, 1063, 1065, 1071, 1072, 1074, 1075, 1076–1078, 3032, 3034, 3042, 3045, 3053, 3054, 3059, 3064, 3065, 3068, 3075, 3082, 3085, 3088, 3089, 3095, 3107, 3110, 3116, 3132, 3134, 3135, 3138, 3140, 3141, 3147, 3149, 3151–3153, 3159, 3161, 3163, 3165, 3167 Pt. A, 3169, 3173–3178, 3183, 3184, 3186, 3188, 3192–3194, 3198, 3200, 3201, 3203, 3204, 3208-3210, 3214-3218, 3221, 3222, 3224–3226, 3232, 3234–3236, 3238, 3240, 3245–3249, 3251, 3253, 3256, 3257, 3259, 3262–3265, 3267, 3272, 3275, 3277, 3283, 3287, 3289, 3296, 3298, 3300, 3304, 3306, 3311, 3314, 3320, 3321, 3324, 3333, 3335, 3336, 3340, 3343, 3344, 3347, 3351, 3353-3355, 3357, 3359-3361, 3368, 3370, 3371, 3384, 3387, 3389, 3391, 3396–3398, 3400, 3404, 3405, 3408, 3412, 3416, 3418, 3424, 3429–3431, 3436–3439, 3448, 3449, 3453, 3462, 3472, 3473, 3475, 3476, 3478, 3488, 3490, 3492–3495, 3498–3500, 3502, 3507–3509, 3516, 3519, 3524, 3526–3528, 3531, 3532, 3539.

Removal or non-fitment of equipment

Removable equipment items

7. If, for any reason, items of non-expendable equipment specified in the Tables No. 1 of Appendices 1 and 2 are omitted, the effect on the aircraft C.G. position must be calculated and, if necessary, equivalent ballast substituted to counteract the C.G. movement.

Fixed equipment items

8. If any items of fixed equipment (included in the tare weight) are omitted, the effect on the aircraft C.G. position must be calculated. The weight and moment of certain major items in this category are listed below for reference.

Item	No. off	Weight (lb.)	Moment (lb. ft.)
Mounting, gyro gunsight, Type 3, Mk.3	2	57·0	— 456
Batteries, lead acid, 12 volt, 40 amp.hr.	2	106·0	—1240
Cylinders, oxygen, 750 litre, Mk.5D	4	64·0	— 669

Ballast

9. When ballast is required, due to the removal or non-fitment of equipment (*para.* 7 *and* 8), this may be installed as follows:—

(a) Ballast of the same weight may be secured in the same manner and on the same mounting as the item it replaces.

(b) Ballast having equivalent effect on the aircraft C.G. may be installed in the ammunition boxes. The weight of such ballast may be calculated using weights and moments, or by using the following formula:—

$$B_A = \frac{M + 0{\cdot}4W_E}{3{\cdot}4}$$

where:— B_A = Weight of the ballast in the ammunition boxes.

M = Total moment change due to the equipment items removed.

W_E = Total weight of the equipment removed.

Example:—

To find the ballast required in the ammunition boxes to counteract the effect of the

removal of 250 lb. of equipment having a total moment change of +1000 lb.ft.

i.e., $M = 1000$
$W_E = 250$

$$\text{Ballast required} = \frac{1000 + 0{\cdot}4 \times 250}{3{\cdot}4} = 324 \text{ lb.}$$

Note . . .

Dummy ammunition may be used for this purpose:—

Ref. No. 12C/881, *Cartridges, S.A., 20 mm. Hispano, ballast, Grade B, Mk.*1, *L.H. feed, belted in Hispano links Mk.*1.

Ref. No. 12C/882, *Cartridges, S.A., 20 mm. Hispano, ballast, Grade B, Mk.*1, *R.H. feed, belted in Hispano links Mk.*1.

Weight=62·5 lb. per 100 rounds.

Max. capacity of ammunition boxes=150 rounds each=600 rounds per aircraft.

(c) Ballast having equivalent effect on the aircraft C.G. may be carried on the stowage bar (Mod. 3298) in the nose. This stowage is designed to carry up to six standard lead ballast weights (A.G.S.670) of 17½ lb. each. The weights and moments of ballast on this stowage are:—

	Weight (lb.)	Moment (lb. ft.)
1 weight	17·5	— 216
2 weights	35·0	— 427
3 weights	52·5	— 635
4 weights	70·0	— 840
5 weights	87·5	—1041
6 weights	105·0	—1239

The number of weights required may be calculated using weights and moments, or by using the following formula:—

$$B_N = \frac{M + 0{\cdot}4W_E}{215}$$

Where:—B_N = Number of 17½ lb. weights required.

M = Total moment change due to the equipment removed.

W_E = Total weight of the equipment removed.

Example:—

To find the number of ballast weights required on the stowage in the nose to counteract the effect of the removal of 250 lb. of equipment having a total moment change of +1000 lb. ft.

i.e., $M = 1000$
$W_E = 250$

$$\text{No. of weights required} = \frac{1000 + 0{\cdot}4 \times 250}{215} = 5$$

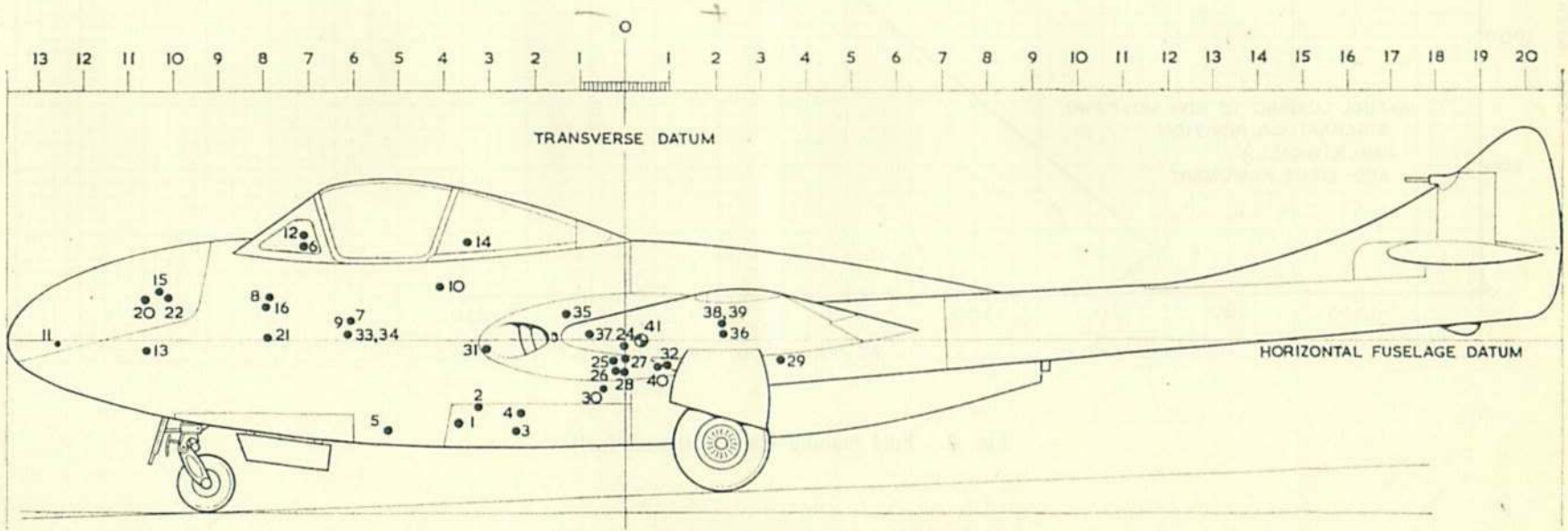

Fig. 1 Loading and C.G. diagram

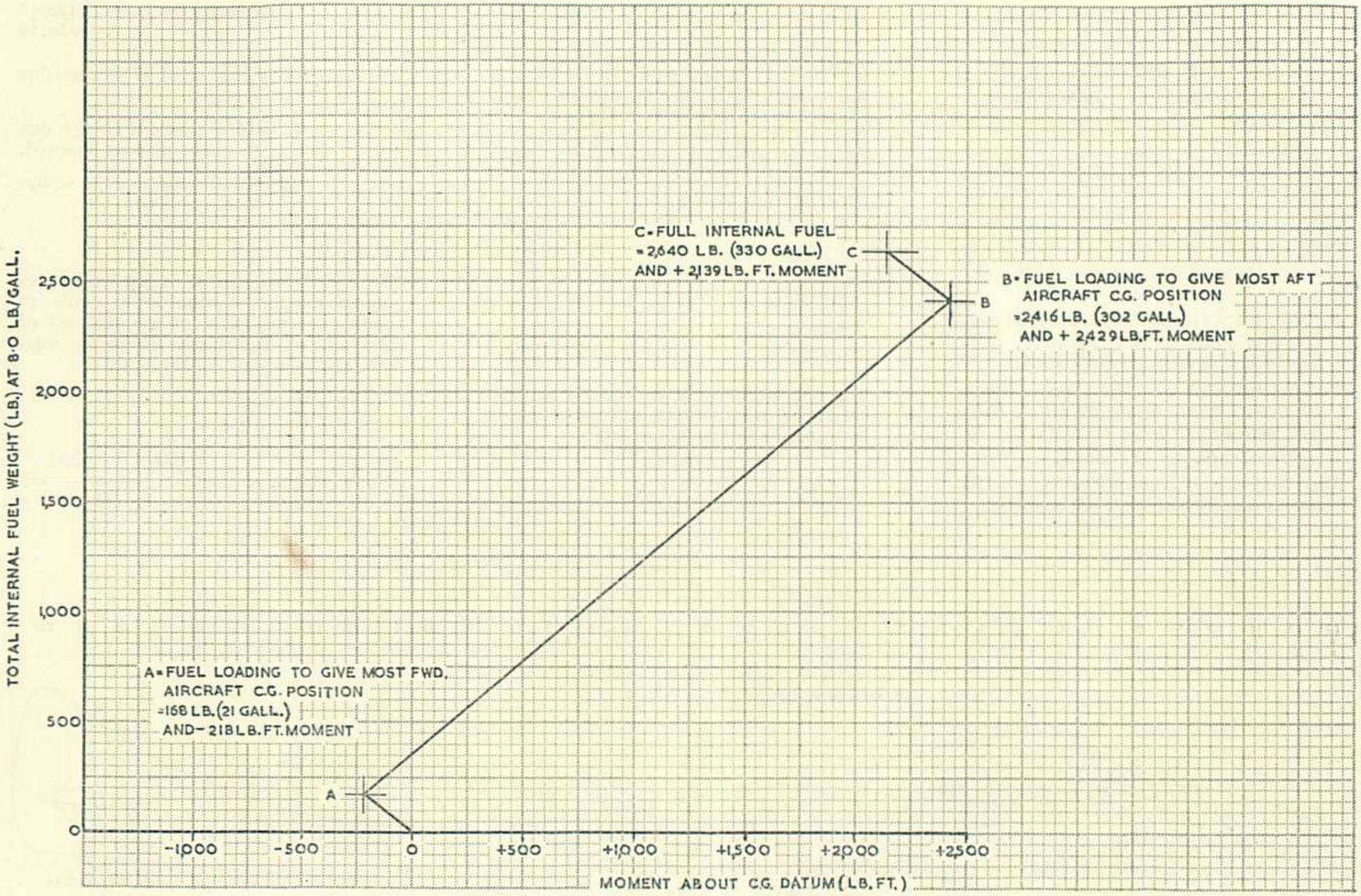

Fig. 2. Fuel loading curve (internal fuel)

Consumable load

10. The normal consumption of fuel or expendable stores from the loadings given in App. 1, Table No. 2, and App. 2, Table No. 2 will not cause the aircraft C.G. position to move beyond the limits quoted in para. 4. The data contained in the following paragraphs will, however, enable the aircraft C.G. position to be determined for any load condition.

Internal fuel

11. The weight and corresponding moment for full internal fuel (330 gall.) are given in App. 1, Table No. 2, and App. 2, Table No. 2. However, when partial fuel loads are carried, the distribution between the various internal tanks is not proportional to their capacities. The plotting of fuel weight against moment is given in fig. 2 to ensure that the correct fuel moment is used for any given fuel weight. Point "A" in fig. 2 defines the fuel loading which gives the most forward aircraft C.G. position, and point " B " defines the most aft position due to internal fuel loading.

Auxiliary fuel

12. When drop tank fuel is carried in addition to internal fuel, an aircraft C.G. position aft of that given by internal fuel loading point " B " in fig. 2 is obtained. The order of fuel consumption via the transfer system is:—

(1) Drop tank fuel. (2) Internal fuel.

Expendable stores

13. The aircraft C.G. position moves *aft* when ammunition is consumed or the bombs or R.Ps. are jettisoned.

Miscellaneous data

14. Length of Standard Mean Chord (S.M.C.) =6·87 ft. Equation to express C.G. position as a decimal of the Standard Mean Chord from its leading edge (C.G. to S.M.C.) is:—

$$\frac{\bar{x}+1\cdot42}{6\cdot87}$$

, where $\bar{x}$ is the moment arm (ft.) of the condition under consideration.

GRAPHICAL PRESENTATION OF LOADING

General information

15. The major roles of the aircraft as given in App. 1, Table No. 2 and App. 2, Table No. 2 are shown in graphical form in the fig. 1 of these Appendices; the illustrations are simply a step-by-step plotting of the total aircraft weight and moment as items are added to the basic aircraft condition. In each illustration, the aircraft weight is indicated by the vertical scale and the total aircraft moment (about the datum) by the horizontal scale; thus the weight and moment associated with a particular loaded condition may be indicated by a single point on the illustration.

16. Since a given 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, obtained by dividing the moment by the weight at any point on the line, is constant. The forward and aft C.G. limits are shown in the illustrations in this manner by continuous lines, intermediate lines of " constant C.G. position " being shown for reference by chain-dotted lines at 0·05 ft. intervals.

17. In order to simplify the illustrations as much as possible, only the loaded conditions which approach either the limiting A.U.W. or C.G. conditions are shown. In each illustration, the appropriate aircraft basic weight as given in the Table No. 1 of Appendices 1 and 2 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 necessary only to assess the total weight and moment of such differences and to apply these total differences to the salient points in the appropriate illustration.

Table 1

Alternative rocket projectiles (aircraft with two or four 20 mm. guns)

The underlisted stores may be carried as alternatives to items 28, 29 and 30 as shown in role 2 in App. 1, Table No. 2, and App. 2, Table No. 2.

1. ALTERNATIVE ROCKET PROJECTILE LOADS ON Mk.8 RAILS (i.e., alternative to item 30 in App. 1, Table No. 2, and App. 2, Table No. 2).

	Item	No. off	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)
1A	Rocket projectile—60 lb. hd.	4	392	—0·07	— 27
1B	Rocket projectile—25 lb. hd.	8	504	+0·47	+237
1C	Rocket projectile—25 lb. hd.	4	252	+0·85	+214

2. ALTERNATIVE TO Mk.8 RAILS (i.e., alternative to items 28 and 29 in App. 1, Table No. 2, and App. 2, Table No. 2).

2A	Rocket launcher, Mk.12, Type 1	4	71	+1·87	+133

Table 1—*continued*

Alternative rocket projectiles (aircraft with two or four 20 mm. guns)

3. ALTERNATIVE ROCKET PROJECTILE LOADS ON Mk.12 LAUNCHERS (i.e., alternative to item 30 in App. 1, Table No. 2, and App. 2, Table No. 2 when item 2A above is fitted).

	Item	No. off	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)
3A	Rocket projectile—25 lb. hd.	12	756	—0·12	— 91
3B	Rocket projectile—25 lb. hd.	8	504	+0·14	+ 71
3C	Rocket projectile—25 lb. hd.	4	252	+0·40	+101
3D	Rocket projectile—18 lb. hd.	12	672	—0·04	— 27
3E	Rocket projectile—18 lb. hd.	8	448	+0·22	+ 99
3F	Rocket projectile—18 lb. hd.	4	224	+0·48	+108
3G	Rocket projectile—12 lb. hd.	12	600	+0·48	+288
3H	Rocket projectile—12 lb. hd.	8	400	+0·74	+296
3I	Rocket projectile—12 lb. hd.	4	200	+1·00	+200
3J	5 in. H.V.A.R.—52 lb. hd.	2	280	+0·71	+199
3K	5 in. H.V.A.R.—38 lb. hd.	2	246	+0·85	+209

Appendix 1 LOADING DATA FOR AIRCRAFT WITH TWO GUNS

(*Completely revised*)

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Introduction

1. This Appendix gives the loading data for the Sea Vampire T Mk.22 aircraft fitted with two 20 mm. Hispano guns. General Information and limitations, irrespective of the modification standard and the number of guns fitted, are contained in Chapter 3 of this Section.

Note . . .

The following fuels are cleared for use in the aircraft:—

Fuel	*Density (lb./gall.)*
AVTAG	7·7
AVTUR	8·0
AVCAT	8·3

The fuel weights given in para. 7 to 10, fig. 1 and Table No. 2 refer to AVTUR, *and must be adjusted when another fuel is used.*

Tare weight

2. The tare weight given on Table No. 1 includes all fixed fittings and equipment not listed in the Table, and conforms with the basic modification standard defined by Chap. 3, para. 6.

Typical service loads

3. The items of removable equipment common to all roles are listed in Table No. 1. Removable equipment items, crew, and fuel to complete the various roles are given in Table No. 2. In each Table, the numbers in the column headed " Item no." are the key to the numbered spots in Chap. 3, fig. 1.

Effect of modifications

4. The following modifications having significant effect on weight and/or C.G. are included in the tare weight. If any of these modifications are not incorporated, their effect must be calculated and, if necessary, load adjusted to counteract the effect of their omission on the aircraft C.G. The effect of modifications other than those listed may be ignored.

Mod. No.	Description	Fixed parts		Removable parts	
		Weight (lb.)	Moment (lb. ft.)	Weight (lb.)	Moment (lb. ft.)
1057	Delete amplifier A.1271 and aerial Type 62	— 1·8	+ 9	—4·2	+42
1059	Delete signal discharger	— 0·3	+ 3	—3·6	+37
1072	Accelerometer, Mk.2/B6, etc., in lieu of accelerometer KB/482/01	+ 0·9	— 6	—	—
1076	Introduce gun safety solenoid 8A/2355	+ 0·2	— 1	+3·0	—7
1078	Introduce battery condition voltmeter 5Q/107	+ 0·8	— 6	—	—
3138	Provision for IFF, Mk.3	+ 8·0	—25	(Table No. 1, note 5)	
3251	Re-designed canopy jettison control	+ 1·5	—11	—	—
3287	Introduce re-designed fire extinguisher system	+ 1·1	—13	—	—
3298	Provision for ballast weights in nose (including bar)	+ 6·3	—74	(Chap. 3, para. 9 (c))	
3300	Introduce anti-g equipment	+10·9	—66	—	—
3311	Introduce windscreen wiper	+10·5	—93	—	—
3473	Introduce cannon mounting slide in steel in lieu of dural	+ 1·0	— 3	—	—
3475	Introduce resetting fire detectors around engine at rib No. 1	— 2·9	— 6	—	—
3494	Introduce additional stiffener at rib No. 2	+ 5·8	+12	—	—
3508	Introduce reinforcing of top rudder hinge in fin	+ 0·7	+13	—	—

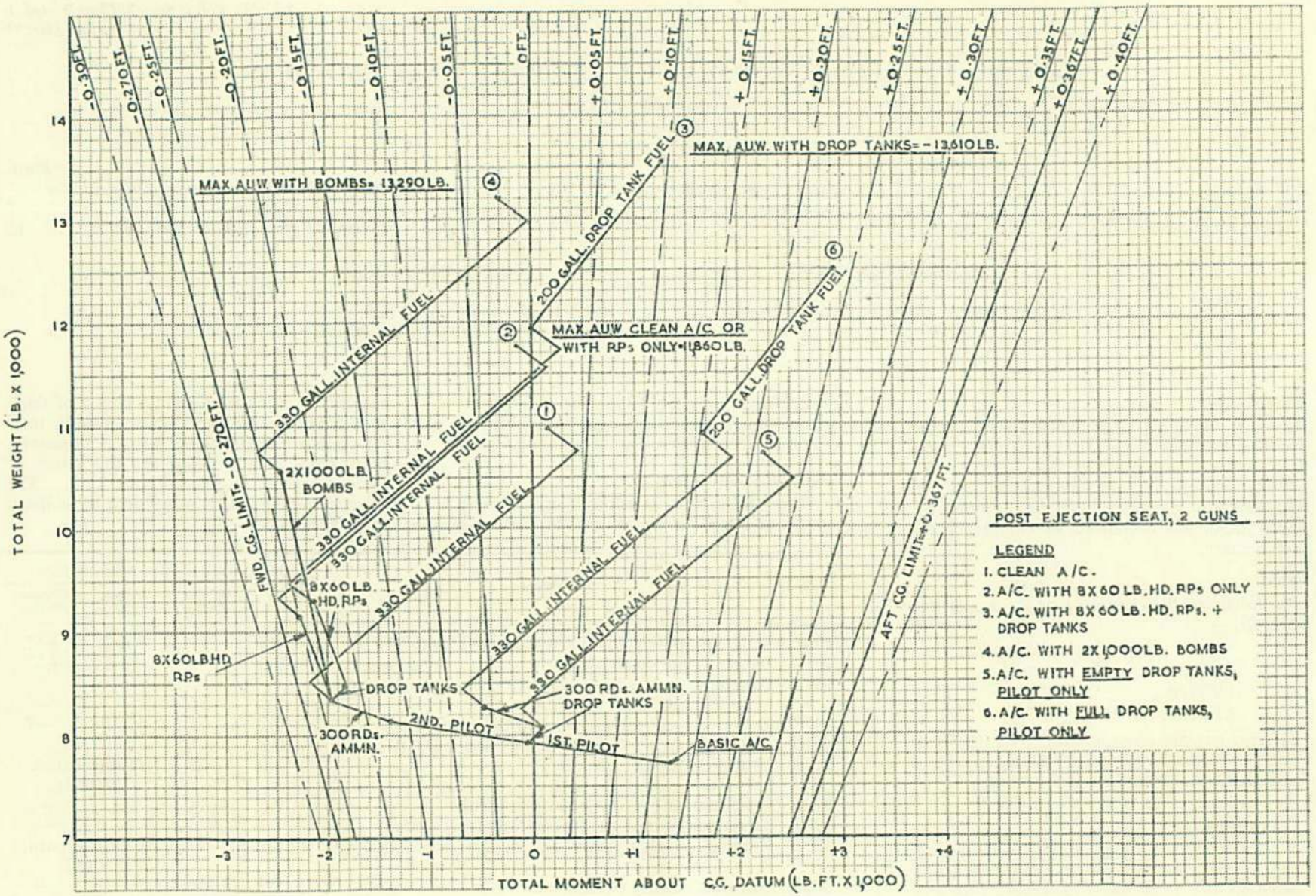

Fig. 1. Weight/moment diagram, aircraft fitted with two guns

5. The following modifications are not included in tare weight given in Table 1. When any of these modifications are introduced, their effect must be calculated and, if necessary, load adjusted to counteract their effect on the aircraft C.G. position.

Mod. No.	Description	Fixed parts		Removable parts	
		Weight (lb.)	Moment (lb. ft.)	Weight (lb.)	Moment (lb. ft.)
	Nil at date of issue of this A.L.				

Loading restrictions

6. When the aircraft is flown with *one crew* and with full drop tanks, 300 rounds of ammunition (or alternatively 8×60 lb. hd. R.Ps.) must be retained or equivalent ballast carried until the fuel transfer from the drop tanks is complete.

Note . . .

This restriction does not apply to aircraft flown under ferrying conditions (*Chap.* 3, *para.* 4).

Examples on the determination of the C.G. position

7. The most forward possible C.G. occurs when the aircraft carries two crew, full ammunition (300 rounds), and 8×60 lb. hd. R.Ps. (i.e., role 2 as shown in Table No. 2 less drop tanks) and with fuel consumed to approx. 21 gall. (Point "A" in Chap. 3, fig. 2).

		Weight (lb.)	Moment (lb. ft.)
A.U.W.	role 2 from Table No. 2	13537	+1273
Deduct	drop tanks	— 150	— 135
Deduct	drop tank fuel	—1600	—1270
Deduct	internal fuel	—2640	—2139
Add	internal fuel (to point "A" in Chap. 3, fig. 2)	+ 168	— 218
	Totals	9315	—2489

C.G. position $= \frac{-2489}{9315} = -0{\cdot}267$ ft. (0·168 S.M.C.)

This is within the range quoted in Chap. 3, para. 4.

8. The most aft possible C.G. with drop tanks empty occurs when the aircraft carries one Pilot, rocket projectors, and empty drop tanks only (i.e., role 2 as shown in Table No. 2 less expendable stores and 2nd Pilot), and with fuel consumed to approx. 302 gall. (Point " B " in Chap. 3, fig. 2).

		Weight (lb.)	Moment (lb. ft.)
A.U.W.	role 2 from Table No. 2	13537	+1273
Deduct	R.Ps.	— 784	+ 353
Deduct	ammunition	— 188	+ 564
Deduct	2nd Pilot	— 222	+1359
Deduct	drop tank fuel	—1600	—1270
Deduct	internal fuel	—2640	—2139
Add	internal fuel (to Point " B " in Chap. 3, fig. 2)	+2416	+2429
	Totals	10519	+2569

C.G. position $= \frac{+2569}{10519} = +0{\cdot}244$ ft. (0·242 S.M.C.)

This is within the range quoted in Chap. 3, para. 4.

9. The most aft possible C.G. with drop tanks full is identical with that given in para. 8 above, except that drop tank fuel is added and 300 rounds of ammunition are carried (*para.* 6). The most aft C.G. in this condition occurs at take-off with full tanks.

	Weight (lb.)	Moment (lb. ft.)
Totals from para. 8	10519	+2569
Add fuel to fill internal tanks	+ 224	— 290
Add drop tank fuel	+1600	+1270
Add 300 rounds of ammunition	+ 188	— 564
Totals	12531	+2985

C.G. position $= \frac{+2985}{12531} = +0{\cdot}238$ ft. (0·241 S.M.C.)

This is within the range quoted in Chap. 3, para. 4.

10. The ferrying C.G. position occurs when the aircraft carries the Pilot only and full drop tanks, but without Service fit items (marked with asterisks in Table No. 1).

		Weight (lb.)	Moment (lb. ft.)
A.U.W.	role 1 from Table No. 2	10975	+ 174
Deduct	ammunition	— 188	+ 564
Deduct	2nd Pilot	— 222	+1359
Add	drop tanks	+ 150	+ 135
Add	drop tank fuel	+1600	+1270
Deduct	Service fit items marked with asterisks in Table No. 1	— 221	+ 811
Add	2 off ballast guns at —3·67 ft.	+ 170	— 624
Add	2 off ballast belt feed mechanism at —3·21 ft.	+ 27	— 87
	Totals	12291	+3602

Ferrying C.G. position $= \frac{+3602}{12291} = +0{\cdot}293$ ft. (0·249 S.M.C.)

This is within the *normal* limit quoted in Chap. 3, para. 4 and the ferrying restriction need not be applied.

11. The above examples show the extreme C.G. positions obtainable with any permissible combination of crew, ammunition, and external stores on aircraft with full Service

equipment as listed in Table No. 1 and in the modification condition defined in para. 2. Further correction to the examples given, in accordance with the instructions given in Chap. 3, para. 7 and 8, and para. 4 and 5 of this Appendix, will determine the extreme C.G. positions obtainable in Service for the particular aircraft or group of aircraft under onsideration.

Graphical presentation of loading

12. General information on the interpretation of the weight/moment diagrams is given in Chap. 3, para. 15 and 17. Fig. 1 shows that, in all instances, there is only a very small margin between the achieved C.G. positions and the forward C.G. limit; close attention should therefore be paid to the effect of modifications which tend to move the C.G. forward when the aircraft is operating with a crew of TWO and full ammunition (300 rounds). The margin between the most aft achieved C.G. positions and the aft C.G. limit is considerable, but, since the C.G. moves rapidly aft when equipment is omitted from the fuselage, it is important that the effect of omitted equipment should be checked carefully.

Table 1

Basic weight, with two 20 mm. guns

Note ref.	Item no.	Item	No. off	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)
		Armament				
(1)	1*	Guns, Hispano 20 mm., Mk.5, No. 2	2	171·0	— 3·67	—628
	2*	Belt feed mechanism, Mk.5	2	27·0	— 3·21	— 87
	3*	Firing units, Maxiflux, Mk.2	2	8·3	— 2·38	— 20
	4*	Gun safety solenoids	2	1·5	— 2·30	— 3
	5	Accessories, guns	2 sets	26·0	— 5·20	—135
(2)	6	Gyro gunsight, Mk.5	2	19·5	— 7·02	—137
		Electrical				
	7*	Torches, Type O	2	1·5	— 6·00	— 9
		Instrument				
	8*	Clock, Mk.4	1	0·5	— 7·74	— 4
	9*	Chart board, Type G	1	5·5	— 6·00	— 33
	10	Map case	1	1·0	— 3·96	— 4
(3)	11	Camera, G.45B and accessories	1	7·3	—12·33	— 90
(4)	12*	G.G.S. recorder, Mk.3	1	2·3	— 7·02	— 16
	13	Oxygen, charge for cylinders	4	9·4	—10·53	— 99
		Miscellaneous				
	14*	First aid outfit, A.P.3130	1	3·0	— 3·50	— 11
		Radio				
	15	V.H.F. trans.-rec. T.R.1936	1	25·0	—10·21	—255
	16	V.H.F. control unit, Type 382	1	0·6	— 7·84	— 5
	20	Z.B.X. rec., Type R.1585	1	6·4	—10·50	— 67
	21	Z.B.X. control unit, Type 345	1	0·9	— 7·84	— 7
	22	Dynamotor, Type DY-2/ARR-2	1	3·0	—10·00	— 30
		TOTAL REMOVABLE MILITARY LOAD ITEMS COMMON TO ALL ROLES ..		320		—1640
	41	TARE WEIGHT		7383	+0·400	+2957
(5)		BASIC WEIGHT		7703	+0·171	+1317

Note . . .

(1) *Gun weight includes rack operating lever.*

(2) *Gun accessories comprise ammunition chutes, empty case and link chutes, blast tubes, magazine stay tubes, and cocking unit.*

(3) *Camera and accessories comprise camera, adapter, mounting and side covers.*

(4) *Recorder and accessories comprise recorder and magazines.*

(5) *Removable parts of the I.F.F. Mk.3 installation are not included in the above basic weights. If carried, the following weights and moments must be added to the above totals:—*

I.F.F. rec. R.3121	*34·3 lb.*	*—164 lb. ft.*
I.F.F. control unit, Type 89	*0·7 lb.*	*— 5 lb. ft.*
I.F.F. control unit, Type 90	*1·1 lb.*	*— 5 lb. ft.*

(6) *Items marked * are " Service Fit " and are not available for fitment to aircraft prior to delivery.*

Table 2—Typical service loads, with two 20 mm. guns

Note ref.	Item no.	Items of removable military load	No. off	Role 1 Clean aircraft			Role 2 Clean aircraft with R.Ps. and drop tanks			Role 3 Clean aircraft with practice bombs			Role 4 Clean aircraft with 500 lb. bombs			Role 5 Clean aircraft with 1000 lb. bombs		
				Weight (lb.)	Arm (ft.)	Moment (lb. ft.)	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)
		ARMAMENT																
(1)	24	Bomb carrier and fairing	2	—	—	—	—	—	—	139	0·00	0	80	0·00	0	80	0·00	0
	25	Bombs, 500 lb.	2	—	—	—	—	—	—	—	—	—	1050	—0·27	— 284	—	—	—
	26	Bombs, 1000 lb. ..	2	—	—	—	—	—	—	—	—	—	—	—	—	2160	—0·225	— 486
	27	Bombs, practice ..	8	—	—	—	—	—	—	200	0·00	0	—	—	—	—	—	—
(3)	28, 29	Rocket projectors, Mk.8	4 sets	—	—	—	28	+1·68	+ 47	—	—	—	—	—	—	—	—	—
	30	Rocket projectiles, 60 lb. hd.	8	—	—	—	784	—0·45	— 353	—	—	—	—	—	—	—	—	—
	31	Cartridges, 20 mm. Hispano	300	188	—3·00	— 564	188	—3·00	— 564	188	—3·00	— 564	188	—3·00	— 564	188	—3·00	— 564
		AUXILIARY FUEL TANKS																
	32	Under-wing drop tanks (100 gall. capacity) ..	2	—	—	—	150	+0·90	+ 135	—	—	—	—	—	—	—	—	—
(2)		CREW																
	33	Ist Pilot..	1	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359
	34	2nd Pilot	1	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359
		TOTAL ROLE EQUIPMENT PLUS CREW		632	—	—3282	1594	—	—3453	971	—	—3282	1762	—	—3566	2872	—	—3768
		FUEL (at 8·0 lb. gall.)																
	35	Fuselage tank 96 gall.		768	—1·30	— 998												
	36	Stub-wing tanks 106 gall.		848	+2·23	—1891												
	37	Leading edge tanks 39 gall.		312	—0·80	— 250		(As role 1)			(As role 1)			(As role 1)			(As role 1)	
	38	Inboard wing tanks 47 gall.		376	+2·10	+ 790												
	39	Outboard wing tanks 42 gall.		336	+2·10	+ 706												
		TOTAL INTERNAL FUEL 330 gall.		2640	—	+2139	2640	—	+2139	2640	—	+2139	2640	—	+2139	2640	—	+2139
	40	Fuel in drop tanks 200 gall.		—	—	—	1600	+0·794	+1270	—	—	—	—	—	—	—	—	—
		TOTAL ROLE EQUIPMENT PLUS CREW AND FUEL		3272	—	—1143	5834	—	— 44	3611	—	—1143	4402	—	—1427	5512	—	—1629
		BASIC WEIGHT From Table No. 1 ..		7703	+0·171	+1317	7703	+0·171	+1317	7703	+0·171	+1317	7703	+0·171	+1317	7703	+0·171	+1317
		A.U.W.		10975	+0·016	+ 174	13537	+0·094	+1273	11314	+0·015	+ 174	12105	—0·009	— 110	13215	—0·023	— 312

Note . . . (1) *Bomb carrier weight for role* 3 *includes light series carrier and adapter.*

(2) *Crew weight includes:—Pilot and parachute* 200 *lb.*
Emergency oxygen 4 *lb.*
Dinghy, Type K 18 *lb.*
Total 222 *lb.*

(3) *Refer to Chap.* 3, *Table* 1 *for details of alternative R.P. loadings.*

Appendix 2 LOADING DATA FOR AIRCRAFT WITH FOUR GUNS

(Completely revised)

LIST OF CONTENTS

ILLUSTRATION

LIST OF TABLES

Introduction

1. This Appendix gives the loading data for the Sea Vampire T Mk.22 aircraft fitted with four 20 mm. Hispano guns. General information and limitations, irrespective of the modification standard and the number of guns fitted, are contained in Chapter 3 of this Section.

Note . . .

The following fuels are cleared for use in the aircraft:—

Fuel	*Density (lb./gall.)*
AVTAG	7·7
AVTUR	8·0
AVCAT	8·3

The fuel weights given in para. 6 to 8, fig. 1 and Table No. 2 refer to AVTUR, *and must be adjusted when another fuel is used.*

Tare weight

2. The tare weight given in Table No. 1 includes all fixed fittings and equipment not listed in the Table, and conforms with the basic modification standard defined in Chap. 3, para. 6.

Typical service loads

3. Items of removable equipment common to all roles are listed in Table No. 1. Removable equipment, crew and fuel to complete the various roles are given in Table No. 2. In each Table, the numbers in the column headed "Item no." are the key to the numbered spots in Chap. 3, fig. 1.

Effect of modifications

4. Refer to App. 1, para. 4 and 5 for the effect of modifications common to post-ejection seat aircraft fitted with either two or four guns; see also Table No. 1, note 5.

Loading restrictions

5. The restriction given in App. 1, para. 6 for aircraft with two guns does NOT apply when four guns are fitted owing to the forward C.G. shift due to the additional two guns. Refer to the notes at the foot of Table No. 2 for restriction on the ammunition load for roles 2 and 5.

Examples on the determination of the C.G. position

6. The most forward possible C.G. occurs when the aircraft is loaded to role 4 as shown in Table No. 2 and fuel has been consumed to approx. 21 gall. (Point "A" in Chap. 3, fig. 2).

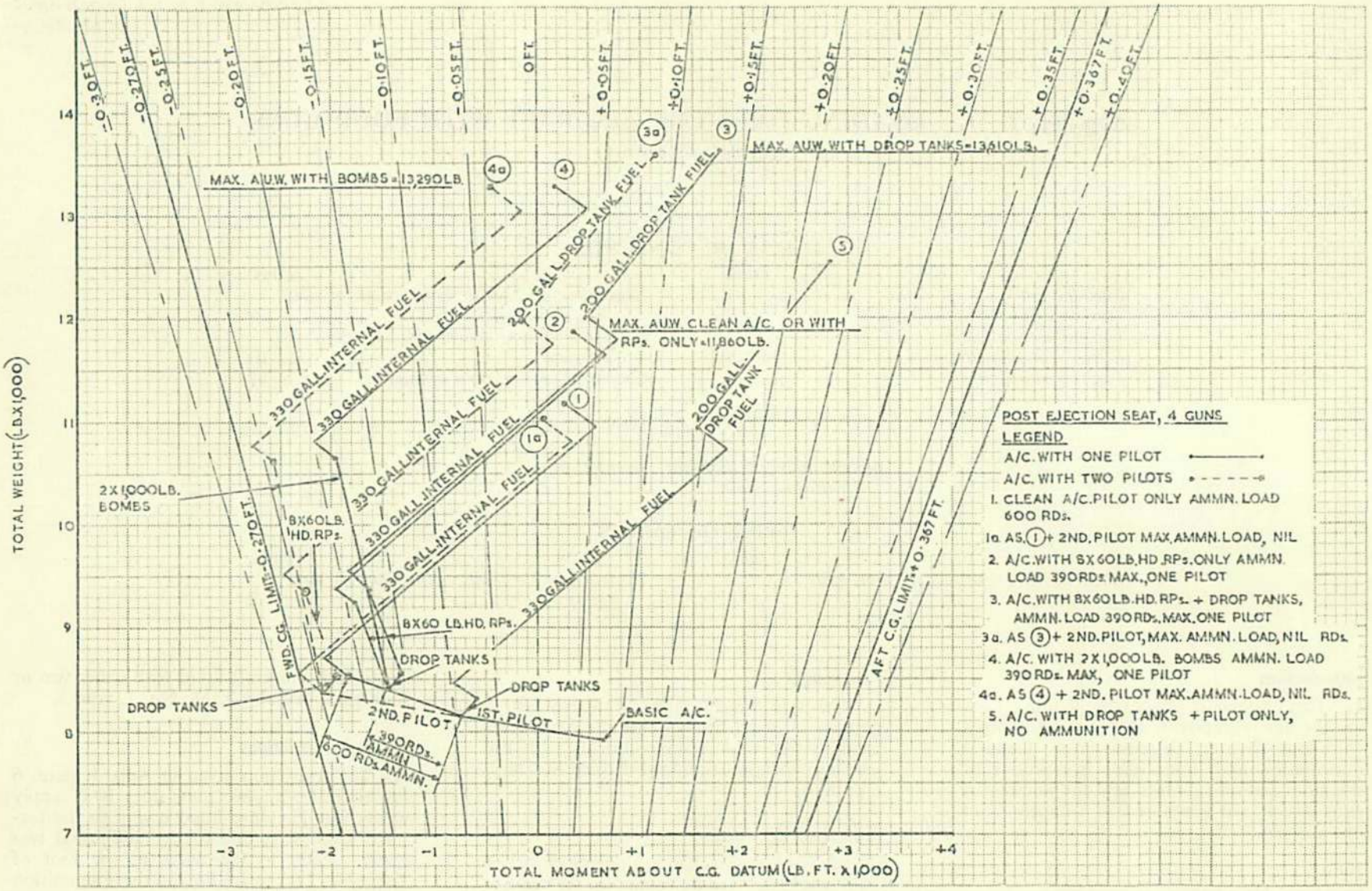

Fig. 1. Weight/moment diagram, aircraft fitted with four guns

		Weight (lb.)	Moment (lb. ft.)
A.U.W. role 4 from	Table No. 2	12304	— 5
Deduct	internal fuel	—2640	—2139
Add	fuel to Point "A" in Chap. 3, fig. 2	+ 168	— 218
	Totals	9832	—2362

$$\text{C.G. position} = \frac{-2362}{9832} = -0{\cdot}240 \text{ ft.} \quad (0{\cdot}172 \text{ S.M.C.})$$

This is within range quoted in Chap. 3, para. 4.

7. The most aft possible C.G. occurs when the aircraft carries rocket projectors and full drop tanks only (i.e., role 2 as shown in Table No. 2 less expendable stores). The most aft C.G. in this condition occurs at take-off with full tanks.

		Weight (lb.)	Moment (lb. ft.)
A.U.W. role 2 from	Table No. 2	13605	+1771
Deduct	R.Ps.	— 784	+ 353
Deduct	ammunition	— 225	+ 675
	Totals	12596	+2799

$$\text{C.G. position} = \frac{+2799}{12596} = +0{\cdot}222 \text{ ft.} \quad (0{\cdot}239 \text{ S.M.C.})$$

This is within range quoted in Chap. 3, para. 4.

8. The ferrying C.G. position occurs when the aircraft carries full drop tanks but without Service fit items (marked with asterisks in Table No. 1).

		Weight (lb.)	Moment (lb. ft.)
A.U.W. role 1 from	Table No. 2	11174	+ 279
Deduct	ammunition	— 375	+1125
Add	drop tanks	+ 150	+ 135
Add	drop tank fuel	+1600	+1270
Deduct	Service fit items	— 428	+1387
Add	4 off, ballast guns at —3·28 ft.	+ 340	—1115
Add	4 off, ballast belt feed mechanism at 2·84 ft.	+ 54	— 153
	Totals	12515	+2928

$$\text{Ferrying C.G. position} = \frac{+2928}{12515} = +0{\cdot}234 \text{ ft.} \quad (0{\cdot}241 \text{ S.M.C.})$$

This is within the *normal* limit quoted in Chap. 3, para. 4 and ferrying restriction need not be applied.

9. The above examples show the extreme C.G. positions obtainable with any permissible combination of ammunition and external stores on aircraft with full Service equipment as listed in Table No. 1 and in the modification condition defined in para. 2, with *one Pilot*. Further correction to the examples given in accordance with instructions of Chap. 3, para. 7 and 8 and para. 4 of this Appendix will determine the extreme C.G. positions obtainable in service for the particular aircraft or group of aircraft under consideration.

Load restrictions when the 2nd Pilot is carried

10. The typical loads given in Table No. 2 and the examples showing most forward and most aft C.G. positions in para. 6 and 7 refer to the aircraft with *one Pilot*. If the *2nd Pilot* is added to the loads given in Table No. 2, the following restrictions (which replace those given in notes 3 and 4 in the Table) must be observed in order that either the forward C.G. limit given in Chap. 3, para. 4, or the A.U.W. limits given in Chap. 3, para. 5 are not exceeded.

Role 1. Clean aircraft:—ammunition must NOT be carried, i.e., permissible ammunition load=ZERO rounds (restricted by forward C.G. limit).

Role 2. Clean aircraft plus R.Ps. and drop tanks:—ammunition must NOT be carried, i.e., permissible ammunition load=ZERO rounds (restricted by A.U.W. and forward C.G. limit).

Note . . .
R.Ps. may only be carried if drop tanks are fitted (restricted by forward C.G. limit).

Role 3. Clean aircraft plus practice bombs:—ammunition must NOT be carried, i.e., permissible ammunition load=ZERO rounds (restricted by forward C.G. limit).

Role 4. Clean aircraft plus 500 lb. bombs:—ammunition must NOT be carried, i.e., permissible ammunition load=ZERO rounds (restricted by forward C.G. limit).

Role 5. Clean aircraft plus 1000 lb. bombs:—ammunition must NOT be carried, i.e., permissible ammunition load=ZERO rounds (restricted by both A.U.W. and forward C.G. limits).

Graphical presentation of loading

11. General information on the interpretation of the weight/moment diagrams is given in Chap. 3, para. 15 to 17. The normal operating condition for aircraft fitted with four guns is ONE PILOT, and therefore the curves in fig. 2 which illustrate this condition are drawn in full lines; these curves show that, to keep the A.U.W. within the appropriate limits, it is necessary to restrict the ammunition load to 390 rounds for all except the CLEAN AIRCRAFT role. There are margins between the C.G. limits and the achieved C.G. positions at both ends of the C.G. range, nevertheless the effect of modifications and equipment changes must be checked to ensure that the weight and C.G. limits are not exceeded.

12. The effect on the aircraft weight and C.G. position when the 2nd Pilot is carried is shown by the curves drawn in dash lines; these show that both the achieved A.U.W. and the forward C.G. position are approximately coincident with the appropriate limiting conditions without ammunition. The ammunition load is therefore restricted to ZERO for all conditions when a crew of TWO is carried. Thus the weight effect of all modifications and the effect on the aircraft C.G. position of modifications which tend to move the C.G. forward must be checked carefully when operating with a crew of TWO.

Table 1

Basic weight, with four 20 mm. guns

Note ref.	Item no.	Item	No. off	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)
		ARMAMENT				
(1)	1*	Guns, Hispano, 20 mm., Mk.5, No. 2	4	342·0	— 3·28	—1121
	2*	Belt feed mechanism, Mk.5	4	54·0	— 2·84	— 153
	3*	Firing units, Maxiflux, Mk.2	4	16·6	— 1·99	— 33
	4*	Gun safety solenoids	4	3·0	— 2·30	— 7
(2)	5	Accessories, guns	4 sets	52·5	— 4·80	— 252
	6	Gyro gunsight, Mk.5	2	19·5	— 7·02	— 137
		ELECTRICAL				
	7*	Torches, Type O	2	1·5	— 6·00	— 9
		INSTRUMENT				
	8*	Clock, Mk.4	1	0·5	— 7·74	— 4
	9*	Chart board, Type G	1	5·5	— 6·00	— 33
	10	Map case	1	1·0	— 3·96	— 4
(3)	11	Camera, G45B and accessories	1	7·3	—12·33	— 90
(4)	12*	G.G.S. recorder, Mk.3	1	2·3	— 7·02	— 16
	13	Oxygen, charge cylinders	4	9·4	—10·53	— 99
		MISCELLANEOUS				
	14*	First aid kit, A.P.3130	1	3·0	— 3·50	— 11
		RADIO				
	15	V.H.F. trans.-sec. T.R.1936	1	25·0	—10·21	— 255
	16	V.H.F. control unit, Type 382	1	0·6	— 7·84	— 5
	20	Z.B.X. rec. Type R.1585	1	6·4	—10·50	— 67
	21	Z.B.X. control unit, Type 345	1	0·9	— 7·84	— 7
	22	Dynamotor, Type DY-2/ARR-2	1	3·0	—10·00	— 30
		TOTAL REMOVABLE MILITARY LOAD ITEMS COMMON TO ALL ROLES		554		—2333
	35	TARE WEIGHT		7383	+0·400	+2957
(5)		BASIC WEIGHT		7937	+0·078	+ 624

Note . . .

(1) *Gun weight includes rack operating lever.*

(2) *Gun accessories comprise, ammunition chutes, empty case and link chutes, blast tubes, magazine stay tubes, and cocking unit.*

(3) *Camera and accessories comprise camera, adapter, mounting and side covers.*

(4) *Recorder and accessories comprise recorder and magazines.*

(5) *Removable parts of the I.F.F. Mk.3 installation are not included in above basic weights. If carried, the following weights and moments must be added to the above totals:—*

I.F.F. rec. R.3121	34·3 *lb.*	—164 *lb. ft.*
I.F.F. control unit, Type 89	0·7 *lb.*	— 5 *lb. ft.*
I.F.F. control unit, Type 90	1·1 *lb.*	— 5 *lb. ft.*

(6) *Items marked * are " Service Fit " and are not available for fitment to aircraft prior to delivery.*

Table 2—Typical service loads, with four 20 mm. guns

Note ref.	Item no.	Items of removable military load	No. off	Role 1 Clean aircraft			Role 2 Clean aircraft with R.Ps. and drop tanks			Role 3 Clean aircraft with practice bombs			Role 4 Clean aircraft with 500 lb. bombs			Role 5 Clean aircraft with 1000 lb. bombs		
				Weight (lb.)	Arm (ft.)	Moment (lb. ft.)	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)	Weight (lb.)	Arm (ft.)	Moment (lb. ft.)
		ARMAMENT																
(1)	24	Bomb carrier and fairing	2	—	—	—	—	—	—	139	0·00	0	80	0·00	0	80	0·00	0
	25	Bombs, 500 lb. ..	2	—	—	—	—	—	—	—	—	—	1050	—0·27	— 284	—	—	—
	26	Bombs, 1000 lb. ..	2	—	—	—	—	—	—	—	—	—	—	—	—	2160	—0·225	— 486
	27	Bombs, practice ..	8	—	—	—	—	—	—	200	0·00	0	—	—	—	—	—	—
	28, 29	Rocket projectors, Mk.8	4 sets	—	—	—	28	+1·68	+ 47	—	—	—	—	—	—	—	—	—
(6)	30	Rocket projectiles, 60 lb. hd.	8	—	—	—	784	—0·45	— 353	—	—	—	—	—	—	—	—	—
(3), (4) & (5)	31	Cartridges, 20 mm. Hispano		375 (600 rounds)	—3·00	—1125	244 (390 rounds)	—3·00	— 732	375 (600 rounds)	—3·00	—1125	375 (600 rounds)	—3·00	—1125	244 (390 rounds)	—3·00	— 732
		AUXILIARY FUEL TANKS																
	32	Under-wing drop tanks (100 gall. capacity)	2	—	—	—	150	+0·90	+ 135	—	—	—	—	—	—	—	—	—
(2)		CREW																
	33	1st Pilot	1	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359	222	—6·12	—1359
	34	2nd Pilot		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		TOTAL ROLE EQUIPMENT PLUS CREW		597	—	—2484	1428	—	—2262	936	—	—2484	1727	—	—2768	2706	—	—2577
		FUEL (at 8·0 lb. gall.)																
	35	Fuselage tank 96 gall.		768	—1·30	— 998												
	36	Stub-wing tanks 106 gall.		848	—2·23	+1891												
	37	Leading edge tanks 39 gall.		312	—0·80	— 250		(As role 1)			(As role 1)			(As role 1)			(As role 1)	
	38	Inboard wing tanks 47 gall.		376	+2·10	+ 790												
	39	Outboard wing tanks 42 gall.		336	+2·10	+ 706												
		TOTAL INTERNAL FUEL 330 gall.		2640	—	+2139	2640	—	+2139	2640	—	+2139	2640	—	+2139	2640	—	+2139
	40	Fuel in drop tanks 200 gall.		—	—	—	1600	+0·794	+1270	—	—	—	—	—	—	—	—	—
		TOTAL ROLE EQUIPMENT PLUS CREW AND FUEL		3237	—	— 345	5668	—	+1147	3576	—	— 345	4367	—	— 629	5346	—	— 438
		BASIC WEIGHT From Table No. 1 ..		7937	+0·078	+ 624	7937	+0·078	+ 624	7937	+0·078	+ 624	7937	+0·078	+ 624	7937	+0·078	+ 624
		A.U.W.		11174	+0·025	+ 279	13605	+0·130	+1771	11513	+0·025	+ 279	12304	+0·000	— 5	13283	+0·014	+ 186

Note . . . (1) *Bomb carrier weight for role* 3 *includes light series carrier and adapter.*

(2) *Crew weight includes:—Pilot and parachute* 200 *lb.*
Emergency oxygen 4 *lb.*
Dinghy, Type K 18 *lb.*
Total 222 *lb.*

(3) *Ammunition load is limited to* 390 *rounds in role* 2 *by the A.U.W. limitation of* 13610 *lb. with drop tanks fitted or, if drop tanks are not carried, by the clean aircraft + R.P. limitation of* 11860 *lb. (Chap.* 3, *para.* 5).

(4) *Ammunition load is limited to* 390 *rounds in role* 5 *by the A.U.W. limitation of* 13290 *lb. with bombs (Chap.* 3, *para.* 5).

(5) *If the* 2*nd Pilot is added to the above loadings, the restrictions on ammunition load given in para.* 10 *must be observed.*

(6) *Refer to Chap.* 3, *Table No.* 1 *for details of alternative R.P. loadings.*

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