# Chapter 3A LOADING AND C.G. DATA

**◄ (POST MOD 4846, 4862) ►**

*(All weights, c.g. positions, and moments in this chapter are in lb, ft, and lb ft units)*

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| CONDITION | A.U.W. |
|---|---|
| NO EXPENDABLE ARMAMENT ◀ | 32744 |
| 2 RED TOP MISSILES | 33551 |
| 1 RED TOP MISSILE | 33148 |
| 2 FIRESTREAK | 33315 |
| 1 FIRESTREAK | 32975 ▶ |

*ACTUAL TAKE-OFF C.G. AT STATED WEIGHTS

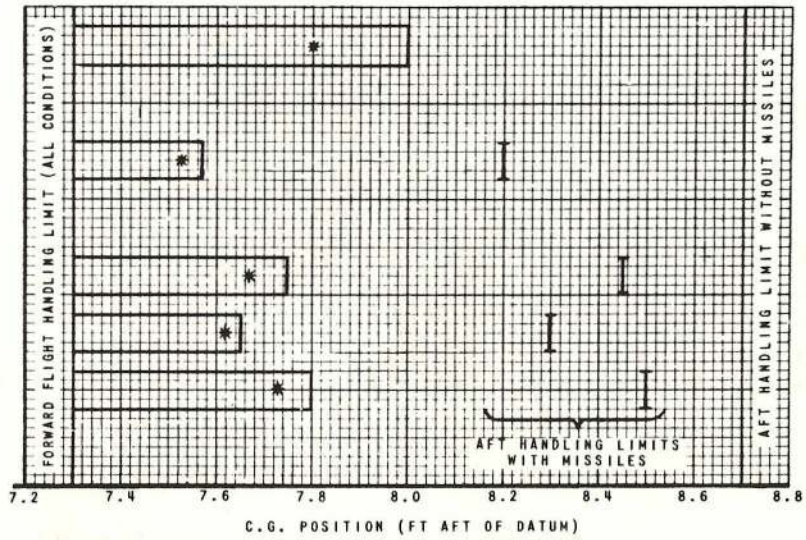


**FIG.1. C.G. TAKE-OFF LIMITS (NO VENTRAL TANK FITTED)**

| CONDITION | A.U.W. |
|---|---|
| NO EXPENDABLE ARMAMENT ◀ | 35073 |
| 2 RED TOP MISSILES | 35880 |
| 1 RED TOP MISSILE | 35476 |
| 2 FIRESTREAK | 35644 |
| 1 FIRESTREAK | 35304 ▶ |

*ACTUAL TAKE-OFF C.G. AT STATED WEIGHTS

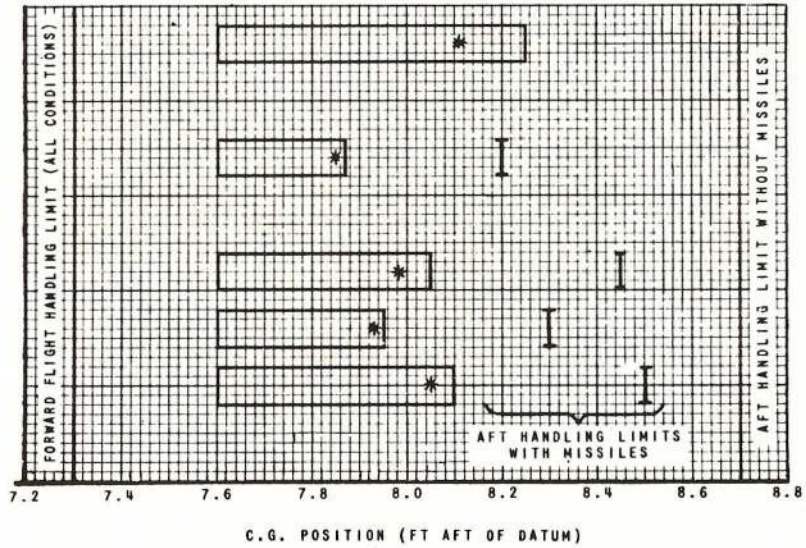


**FIG.2. C.G. TAKE-OFF LIMITS (VENTRAL TANK FITTED)**



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**General information**

1. This chapter deals with the effect of different and varying loads on the c.g. position. Take-off c.g. data has been calculated with the fuselage horizontal datum level and the alighting gear down.

**C.G. datum**

2. The c.g. datum is 0.354 ft aft of frame 25 (fuselage transport joint), on the fuselage longitudinal datum. It is indicated by a screw hole marked C.G. DATUM, on the port side of the fuselage. This screw hole is used to suspend a plumbline, enabling dimensional checks to be made during weighing operations.

**C.G. take-off limits**

3. Fig. 1 and 2 specify take-off limits with the aircraft in a variety of conditions. If these limits are observed, the flight handling limits, for aircraft with all-up weights as quoted, will not be exceeded due to the expending of armament stores.

**Effect of alighting gear retraction**

4. The retraction of the alighting gear introduces a moment + 5140 lb ft which must be taken into account when making calculations which assume flight conditions.

**Basic weight and c.g.**

5. Tables 3, 4 and 5, and fig.1 and 2. refer to a basic weight of 26,509 lb, and a basic c.g. of +8.456 ft aft of the datum point. These figures are based on the mean corrected basic weight of aircraft No. XP 695, XP 750, XP 753 inclusive. For weight of individual aircraft refer to Form 4908 of the aircraft concerned.

**Engine and jet pipe weight and c.g.**

6. The basic weight tolerances of these components affect the aircraft moment whenever such components are changed; when this occurs the aircraft moment must be re-assessed. To assist in calculating the component moment, for inclusion in the aircraft moment, fig.3 relates the component c.g. data, and c.g. positions relative to component data, to the aircraft c.g. datum; it also gives an equation to be used for the calculation. Fig.4 shows a specimen R.A.F. Form 4908 in which hypothetical figures are used to illustrate the method of recording the change.

**Maximum all-up weight**

7. The aircraft is cleared for operational flying at the following maximum all-up weight:-

| | |
|---|---|
| Take-off | 36,000 lb |

**Weighing the aircraft**

8. Details of the application of hydrostatic weighing units to this aircraft are given in Chap. 3B. For the method of weighing an aircraft refer to A.P. 101A-1101-1.

**Modifications**

9. The basic weight *(Tables 3 and 4)* is in accordance with Modification Standard No. Lightning Mk. 3/Y/1 + Mod.

*(See Modification Standard overleaf)*

**Flight refuelling configuration**

10. The effect of fitting the flight refuelling probe and the associated removable fittings gives a weight and moment change of +217 lb and +401 lb ft.

# MODIFICATION STANDARD LTG 3YI

**PLUS**

1621 1888 1896 2036 2086 2122 2129 2136 2137 2140 2141 2142 2150 2164 2180 2197 2227 2235 2262 2263
2292 2315 2321 2355 2364 2365 2367 2368 2369 2373 2374 2379 2383 2388 2389 2390 2391 2392 2395 2400
2401 2404 2405 2411 2434 2435 2436 2444 2456 2457 2461 2467 2471 2477 2479 2487 2497 2500 2502 2503
2508 2510 2511 2512 2514 2515 2523 2529 2538 2540 2549 2553 2557 2558 2564 2566 2567 2568 2569 2571
2573 2583 2585 2588 2590 2592 2596 2597 4006 4010 4012 4014 4020 4021 4023 4028 4031 4037 4040 4046
4048 4052 4055 4063 4078 4079 4082 4093 4096 4097 4100 4104 4105 4107 4109 4116 4118 4119 4126 4127
4130 4131 4132 4133 4136 4138 4146 4148 4151 4152 4156 4157 4158 4160 4163 4165 4166 4169 4173 4175
4179 4185 4186 4190 4193 4194 4197 4198 4200 4204 4208 4211 4213 4217 4223 4224 4227 4232 4233 4235
4245 4250 4253 4255 4256 4259 4267 4276 4283 4291 4293 4295 4301 4306 4318 4321 4327 4330 4343 4350
4352 4359 4382 4388 4390 4398 4415 4425 4432 4438 4440 4447 4448 4450 4452 4458 4462 4466 4467 4469
4473 4475 4484 4487 4495 4496 4497 4502 4506 4507 4508 4510 4526 4527 4528 4529 4536 4538 4539 4541
4542 4553 4554 4555 4562 4564 4566 4567 4572 4578 4590 4599 4601 4607 4609 4618 4619 4622 4623 4632
4633 4636 4637 4638 4641 4643 4645 4649 4656 4657 4666 4667 4668 4680 4687 4690 4691 4693 4694 4697
4702 4705 4713 4714 4717 4722 4728 4741 4744 4747 4749 4752 4753 4763 4764 4772 4774 4778 4781 4792
4796 4808 4811 4820 4846 4862

**MINUS**

29 138 255 353 439 477 1528 1819 1851 1893 1897 1961 1979 2030 2259 2307 2320 2331 2408 2446
2356

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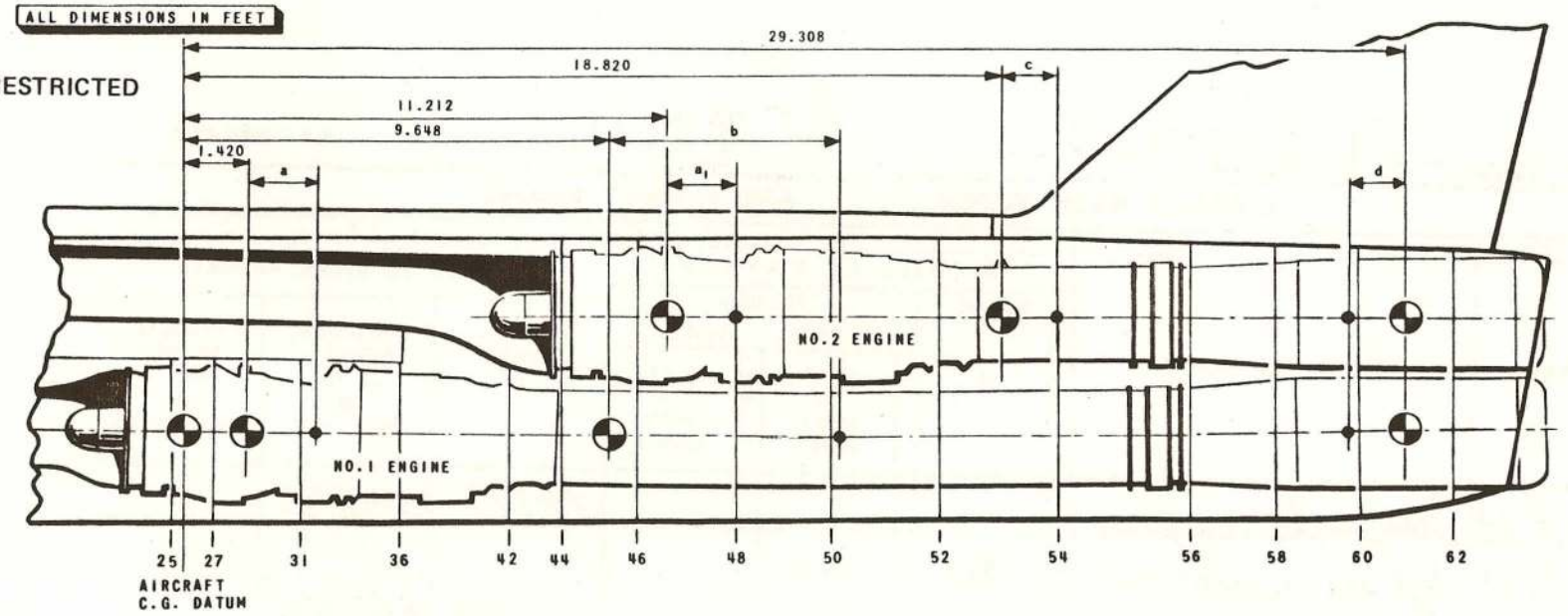


| COMPONENT | COMPONENT C.G. DATUM | POSITION OF COMPONENT C.G. DATUM RELATIVE TO A/C C.G. DATUM | REF. LETTER FOR DISTANCE FROM COMPONENT C.G. TO COMPONENT DATUM | EQUATION* TO GIVE MOMENT (lb ft) FOR R.A.F. FORM 4908 |
|---|---|---|---|---|
| NO.1 ENGINE | ℄ OF FRONT SUSPENSION | 1.420 FT | a | W(1.420 + a) |
| NO.1 ENGINE INTERMEDIATE JET PIPE | ℄ FRONT HANDLING ROLLER | 9.648 FT | b | W(9.648 + b) |
| NO.1 ENGINE REHEAT JET PIPE | MAIN TRUNNION (REAR SUSPENSION) | 29.308 FT | d | W(29.308 - d) |
| NO.2 ENGINE | ℄ OF FRONT SUSPENSION | 11.212 FT | $a_1$ | W(11.212 + $a_1$) |
| NO.2 ENGINE INTERMEDIATE JET PIPE | ℄ FRONT HANDLING BRACKET | 18.820 FT | c | W(18.820 + c) |
| NO.2 ENGINE REHEAT JET PIPE | MAIN TRUNNION (REAR SUSPENSION) | 29.308 FT | d | W(29.308 - d) |

* WHERE W = WEIGHT OF COMPONENTS (LB)
a, $a_1$, b, c, d = C.G. POSITIONS QUOTED ON ENGINE AND JET PIPE LOG AND RECORD CARDS

NOTE:- a, $a_1$, b, c, and d are usually quoted in inches and MUST be converted to feet for the purposes of this calculation

**FIG. 3. ENGINE AND JET PIPES C.G. POSITION RELATIVE TO AIRCRAFT C.G. DATUM**

A22146-1

| AIRCRAFT No. | AIRCRAFT TYPE | MARK | SERIAL No. | R.A.F. FORM 4908 |
|---|---|---|---|---|
| | LIGHTNING | F Mk.3 | XP – | |

**AIRCRAFT BASIC WEIGHT AND MOMENT RECORD**

| 1 | 2 | 3 | | | | | 4 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | DETAILS OF CHANGE | | | | | CORRECTED BASIC FIGURES | | |
| | | WEIGHT | | MOMENT | | | | | |
| | | | | HORIZONTAL | | VERTICAL | | | |
| DATE | REASON FOR CHANGE | + – | LB. | + – | LB. FT. OR INDEX UNITS | + – | LB. FT. OR INDEX UNITS | WEIGHT LB. | HORIZONTAL MOMENT LB. FT. OR INDEX UNITS | VERTICAL MOMENT LB. FT. OR INDEX UNITS |
| 3-6-63 | From initial weighing | | | | | | | 24787 | +206707 | |
| 5-10-63 | No.1 engine removed | – | 2965 | – | 9414 | | | | | |
| 5-10-63 | Replacement-No.1 engine | + | 3001 | + | 9303 | | | 24823 | +206596 | |
| 28-10-63 | No.2 engine removed | – | 2990 | – | 9493 | | | | | |
| 28-10-63 | Replacement-No.2 engine | + | 2975 | + | 9297 | | | 24808 | +206400 | |

Fig.4. Aircraft basic weight and moment record card

TABLE 1

Removable load items

| FIG.5 ITEM NO. | REF. OR PART NO. | QTY. | DESCRIPTION | WEIGHT (lb) | ARM (FT) POSITIVE | ARM (FT) NEGATIVE | MOMENT (LB FT) POSITIVE | MOMENT (LB FT) NEGATIVE |
|---|---|---|---|---|---|---|---|---|
| 30 | 5J/3336 | 1 | Battery, Type 25 A/H..... | 35.02 | | 0.880 | | 30.82 |
| 44 | 5J/3340 | 1 | Emergency battery, 0.4 A/H..... | 3.24 | | 5.710 | | 18.50 |
| 11 | 8B/4230 | 1 | L.F.S. sighting head, Type 2, Mk.1..... | 7.75 | | 9.450 | | 73.24 |
| 4 | 8B/4506 | 1 | L.F.S. control unit, Type L, Mk.4..... | 1.80 | | 12.940 | | 23.29 |
| 23 | 5UB/4938 | 1 | Inverter, Type 100A..... | 6.00 | | 4.496 | | 26.98 |
| 42 | 6G/36 | 1 | M.R.G., Type E, Mk.1..... | 37.00 | | 5.000 | | 185.00 |
| 5 | 6D/2159 | 1 | Liquid oxygen container, 3½ litre, Mk.6.... | 17.82 | | 12.792 | | 227.95 |
| 2 | 14A 4929 | 1 | Camera, G90, Mk.1..... | 4.25 | | 14.000 | | 59.50 |
| 17 | 6D/2284 | 1 | Emergency oxygen set..... | 2.80 | | 6.990 | | 19.57 |
| 43 | 6TD/616 | 1 | Flight control computer..... | 31.25 | | 5.640 | | 176.25 |
| 13 | 6T/620 | 1 | Pilot's controller..... | 8.00 | | 8.600 | | 68.80 |
| 27 | 6T/605 | 3 | Gyro unit, Type B..... | 5.52 | | 2.820 | | 15.57 |
| 21 | 6A/6825 | 1 | Air data computer, Type 'A'..... | 26.00 | | 5.760 | | 149.76 |
| 8 | 6A/6827 | 1 | Pitot-static transducer, Type A..... | 5.00 | | 10.283 | | 51.42 |
| 7 | 6A/6826 | 1 | Static transducer, Type A..... | 5.00 | | 10.320 | | 51.60 |
| | | | **A.R.I.18124/1 (U.H.F.)** | | | | | |
| 10 | 10L/932-2267 | 1 | Control unit C1607/1..... | 3.00 | | 9.750 | | 29.25 |
| 29 | 10D/942-8542 | 1 | Transmitter-receiver, Type 5..... | 48.50 | | 1.980 | | 96.03 |
| 25 | 10D/20773 | 1 | Transmitter-receiver, standby (A.R.I.23057) | 10.85 | | 3.800 | | 41.23 |
| 38 | 10D/20572 | 1 | A.F.unit, Type 9635, Homer (A.R.I.18124/4). | 5.75 | | 3.450 | | 19.84 |
| 24 | 10D/20571 | 1 | R.F.unit, Type 11037, Homer (A.R.I.18124/4) | 10.25 | | 3.950 | | 40.49 |
| | | | **A.R.I.18107/2 (TACAN)** | | | | | |
| 22 | 10AJ/251 | 1 | Mounting, Type 9274..... | 6.00 | | 4.600 | | 27.60 |
| 47 | 10L/16867 | 1 | Control unit, Type 9273A..... | 1.00 | | 8.720 | | 8.72 |
| 39 | 10D/23349 | 1 | Coupling unit, Type 13555..... | 4.35 | | 3.550 | | 15.44 |
| 41 | 10D/22927 | 1 | Transmitter-receiver, Type RT 220C..... | 53.00 | | 4.600 | | 243.80 |
| | | | **A.R.I.18011 (I.L.S.)** | | | | | |
| 48 | 10L/16749 | 1 | Control unit, Type 705A..... | 1.75 | | 9.280 | | 16.24 |
| 33 | 10D/21517 | 1 | Localizer marker receiver R 1964B..... | 18.02 | 14.210 | | 256.06 | |
| 35 | 10D/21518 | 1 | Glide path receiver T 1965B..... | 16.58 | 17.820 | | 295.46 | |

*continued...*

TABLE 1 Removable load items - *continued*

| FIG.5 ITEM NO. | REF. OR PART NO. | QTY. | DESCRIPTION | WEIGHT (lb) | ARM (FT) POSITIVE | ARM (FT) NEGATIVE | MOMENT (LB FT) POSITIVE | MOMENT (LB FT) NEGATIVE |
|---|---|---|---|---|---|---|---|---|
| | | | **A.R.I.5897/7 (A.I.23D)** | | | | | |
| 18 | 10D/9134930 | 1 | Computer, external Type X 16020..... | 9.75 | | 6.880 | | 67.08 |
| 16 | 10L/9134929 | 1 | Hand controller, Type X 16016..... | 4.50 | | 7.810 | | 35.15 |
| 12 | 10L/9134926 | 1 | External receiver control unit, Type X 16891 | 0.60 | | 9.400 | | 5.64 |
| 20 | 10D/9134947 | 1 | Gyro unit, Type X 16868..... | 16.75 | | 5.810 | | 97.32 |
| 6 | 27UA/1052 | 1 | Heat exchanger, D.603/1A..... | 4.98 | | 11.600 | | 57.77 |
| 9 | 10Q/9134909 | 1 | C.R.T. indicator, Type 16017..... | 12.00 | | 10.010 | | 120.12 |
| 19 | 10D/6434770 | 1 | Marker unit, Type X 16009..... | 17.50 | | 5.890 | | 103.08 |
| 1 | 10D/6434760 | 1 | Radar unit, Type X 12982..... | 225.00 | | 14.130 | | 3179.25 |
| 45 | 10D/9134916 | 1 | Receiver, external, Type X 16015..... | 23.5 | | 5.890 | | 138.42 |
| 31 | 10D/6434774 | 1 | Visual recorder, Type X 12730..... | 20.00 | 11.060 | | 221.00 | |
| 3 | 10U/17574 | 1 | Line amplifier, Type X 16007..... | 1.37 | | 13.940 | | 19.10 |
| | | | **A.R.I. 23232/5 (RADAR ALTIMETER)** | | | | | |
| 26 | 5841-99-116-3331 | 1 | Transmitter - receiver 0101 HRA1 ..... | 7.50 | | 4.00 | | 30.00 |
| 14 | SF/48 AMR/CP/1 | 1 | Radio height indicator ..... | 1.60 | | 9.48 | | 14.22 |
| | | | **A.R.I. 23134/3 (IFF 1520)** | | | | | |
| 34 | 10D/9563378 | 1 | Transponder Type 16928 ..... | 30.25 | 16.484 | | 498.04 | |
| 32 | 5895-99-107-1521 | 1 | Aerial Switch unit, 16941 ..... | 2.00 | 14.030 | | 28.06 | |
| 46 | | 1 | Control unit 16929 ..... | 2.00 | | 9.20 | | 18.40 |
| | | | **OTHER ITEMS** | | | | | |
| | | | Ballast..... | | REFER TO LOADING SHEETS | | | |
| 37 | 15D/508 | 1 | Brake parachute, Type LB2, Mk.1..... | 34.00 | 27.790 | | 944.86 | |
| 15 | 27C/2395 | 1 | Personal survival pack, Type V..... | 21.00 | | 8.330 | | 174.93 |
| 37A | 26DK/138 | 1 | * Ventral tank assembly..... | 354.00 | 12.667 | | 4484.00 | |

**Note:-** *The items marked * are not included in the basic weight referred to in para.5.*

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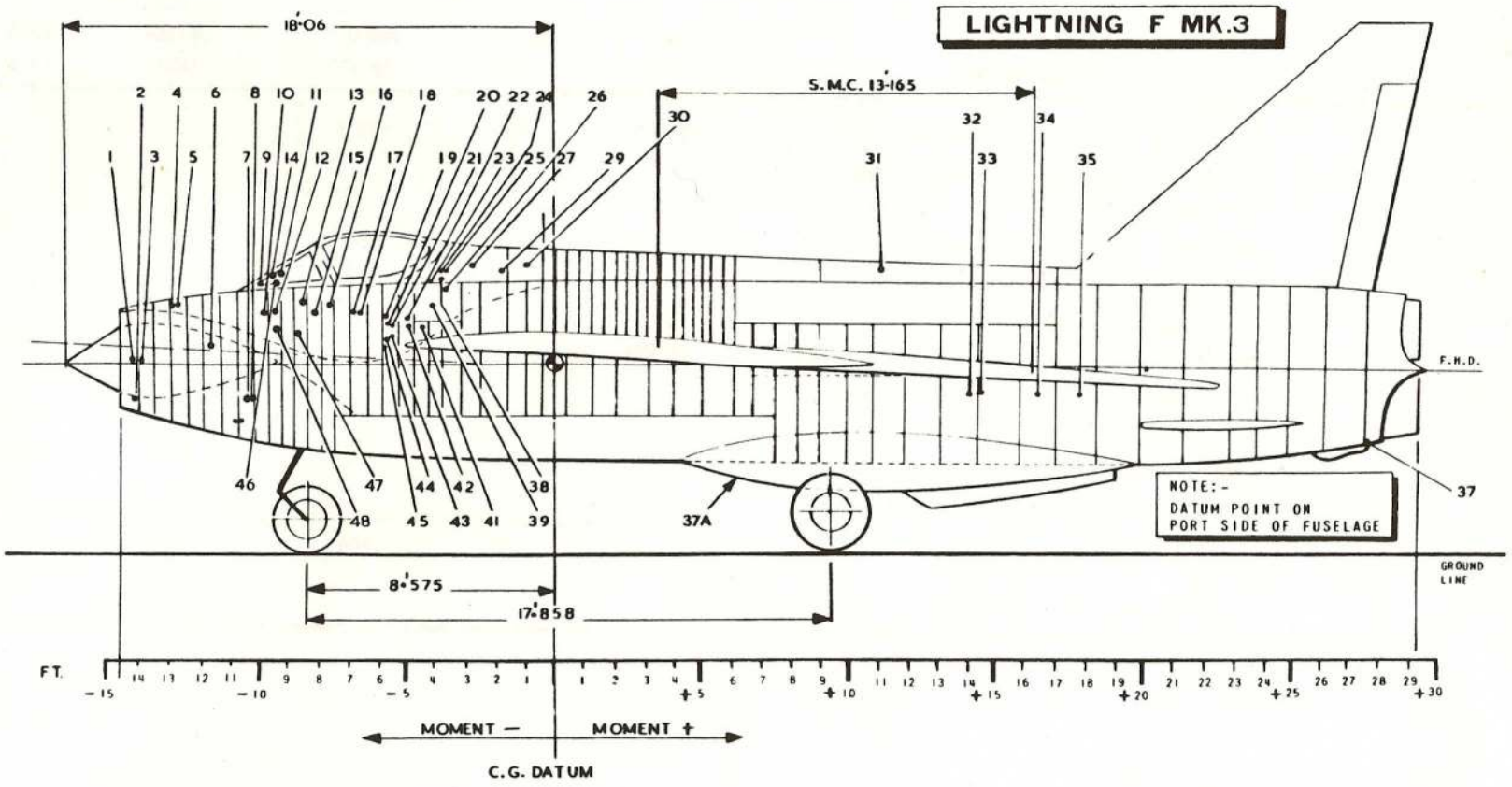


FIG. 5. LOADING AND C.G. DIAGRAM—REMOVABLE LOAD ITEMS

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◀ ITEMS 28, 36 AND 40 DELETED ▶

## TABLE 2

### Alternative load items

| REF. OR PART NO. | QTY. | DESCRIPTION | ARM (FT) | RED TOP ROLE WEIGHT (LB) | RED TOP ROLE MOMENT (LB FT) | FIRESTREAK ROLE WEIGHT (LB) | FIRESTREAK ROLE MOMENT (LB FT) |
|---|---|---|---|---|---|---|---|
| EF3.96.1 | | Red Top pack (including base fairings)... | -5.090 | 450 | -2291 | | |
| | | Launching shoes (change weight - base fairings removed)..... | -3.281 | 57 | - 187 | | |
| | 1 | Red Top..... | -2.947 | 375 | -1105 | | |
| | 1 | Red Top..... | -2.947 | 375 | -1105 | | |
| 26DK/79 | | Firestreak pack (including base fairings)..... | -4.834 | | | 342 | -1653 |
| 75BB/9465923 | | Launching shoes (change weight - base fairings removed)..... | -3.088 | | | 57 | - 176 |
| 75BB/NN | 1 | Firestreak..... | -2.935 | | | 311 | - 913 |
| 75BB/NN | 1 | Firestreak..... | -2.935 | | | 311 | - 913 |
| | | TOTAL FOR ALTERNATIVE ROLES | | 1257 | -4688 | 1021 | -3655 |

* ADD TOGETHER FOR 2 MISSILES

## TABLE 3

### Fuel load and all-up weight summary (AVTUR)

| | RED TOP ROLE | | | FIRESTREAK ROLE | | |
|---|---|---|---|---|---|---|
| | WEIGHT (LB) | ARM (FT) | MOMENT (LB FT) | WEIGHT (LB) | ARM (FT) | MOMENT (LB FT) |
| A/C basic weight (less ventral tank)... | 26509 | +8.456 | +224153 | 26509 | + 8.456 | +224153 |
| Pilot and equipment..... | + 208 | - 7.844 | - 1632 | + 208 | - 7.844 | - 1632 |
| Role equipment (from Table 2)..... | + 1257 | - 3.730 | - 4688 | + 1021 | - 3.580 | - 3655 |
| Internal fuel at 7.9 lb/gal..... | + 5577 | + 6.102 | + 34032 | + 5577 | + 6.102 | + 34032 |
| A.U.W. less V/tank and V/tank fuel..... | 33551 | | +251865 | 33315 | | +252898 |
| C.G. position u/c down | | + 7.507 | | | + 7.591 | |
| Add to above | | | | | | |
| Ventral fuel tank..... | + 354 | +12.667 | + 4484 | + 354 | +12.667 | + 4484 |
| Ventral tank fuel at 7.9 lb/gal..... | + 1975 | +12.353 | + 24391 | + 1975 | +12.353 | + 24391 |
| A.U.W. with ventral tank and fuel..... | 35880 | | +280740 | 35644 | | +281773 |
| C.G. position u/c down..... | | + 7.824 | | | + 7.905 | |

## TABLE 4

### Fuel load and all-up weight summary (AVTAG)

| | RED TOP ROLE | | | FIRESTREAK ROLE | | |
|---|---|---|---|---|---|---|
| | WEIGHT (LB) | ARM (FT) | MOMENT (LB FT) | WEIGHT (LB) | ARM (FT) | MOMENT (LB FT) |
| A/c basic weight (less ventral tank)... | 26509 | + 8.456 | +224153 | 26509 | + 8.456 | +224153 |
| Pilot and equipment..... | + 208 | - 7.844 | - 1632 | + 208 | - 7.844 | - 1632 |
| Role equipment (from Table 2)..... | + 1257 | - 3.730 | - 4688 | + 1021 | - 3.580 | - 3655 |
| Internal fuel at 7.7 lb/gal..... | + 5436 | + 6.102 | + 33170 | + 5436 | + 6.102 | + 33170 |
| A.U.W. less V/tank and V/tank fuel..... | 33410 | | +251003 | 33174 | | +252036 |
| C.G. position u/c down..... | | + 7.513 | | | + 7.597 | |
| Add to above | | | | | | |
| Ventral fuel tank..... | + 354 | +12.667 | + 4484 | + 354 | +12.667 | + 4484 |
| Ventral tank fuel at 7.7 lb/gal..... | + 1925 | +12.353 | + 23780 | + 1925 | +12.353 | + 23780 |
| A.U.W. with ventral tank and fuel..... | 35689 | | +279267 | 35453 | | +280300 |
| C.G. position u/c down..... | | + 7.825 | | | + 7.906 | |

EFFECT OF UNDERCARRIAGE RETRACTION + 5140 LB FT

**NOTE:** *1. The appropriate amount of fuel must be omitted from all cases which exceed the max. permissible weight of 36,000 lb.*

*2. The max permissible weight must also be considered when calculating cases with F/R probe fitted.*

## TABLE 5

### Fuel load and all-up weight summary (AVCAT)

| | RED TOP ROLE | | | FIRESTREAK ROLE | | |
|---|---|---|---|---|---|---|
| | WEIGHT (LB) | ARM (FT) | MOMENT (LB FT) | WEIGHT (LB) | ARM (FT) | MOMENT (LB FT) |
| A/C basic weight (less ventral tank)... | 26509 | + 8.456 | +224153 | 26509 | + 8.456 | +224153 |
| Pilot and equipment..... | + 208 | - 7.844 | - 1632 | + 208 | - 7.844 | - 1632 |
| Role equipment (from Table 2)..... | + 1257 | - 3.730 | - 4688 | + 1021 | - 3.580 | - 3655 |
| Internal fuel at 8.1 lb/gal..... | + 5718 | + 6.102 | + 34897 | + 5718 | + 6.102 | + 34897 |
| A.U.W. less V/tank and V/tank fuel..... | 33692 | | +252730 | 33456 | | +253763 |
| C.G. position u/c down..... | | + 7.501 | | | + 7.585 | |
| Add to above | | | | | | |
| Ventral fuel tank..... | + 354 | +12.667 | + 4484 | + 354 | +12.667 | + 4484 |
| Ventral tank fuel at 8.1 lb/gal..... | + 2025 | +12.353 | + 25015 | + 2025 | +12.353 | + 25015 |
| A.U.W. with ventral tank and fuel..... | 36071 | | +282229 | 35835 | | +283262 |
| C.G. position u/c down..... | | + 7.824 | | | + 7.905 | |
| EFFECT OF UNDERCARRIAGE RETRACTION + 5140 LB FT | | | | | | |

**NOTE:** *1. The appropriate amount of fuel must be omitted from all cases which exceed the max. permissible weight of 36,000 lb.*

*2. The max permissible weight must also be considered when calculating cases with F/R probe fitted.*