TECHNICAL MANUAL

WEIGHT AND BALANCE DATA

MODEL __________ AIRCRAFT
SERIAL NO.____________________

PUBLISHED BY DIRECTION OF THE COMMANDER, NAVAL AIR SYSTEMS COMMAND

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MODEL ________ AIRCRAFT
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Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

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Total number of pages in this manual is 36 consisting of the following:

Page No.	# Change No.	Page No.	# Change No.	Page No.	# Change No.
Title	0				
A	0				
i	0				
ii Blank	0				
1-1 — 1-2	0				
2-1 — 2-3	0				
2-4 Blank	0				
3-1 — 3-14	0				
4-1	0				
4-2 Blank	0				
4-3 — 4-11	0				
4-12 Blank	0				

Zero in this column indicates an original page.

Table of Contents

List of Illustrations

SECTION I
INTRODUCTION

1-1. PURPOSE. This manual of weight and balance data provides service activities with a standard system of field weight and balance control. It contains brief instructive information and is to be used as the permanent binder for the forms and charts which provide the means for continuous record and control of weight and balance of the aircraft. The data to be inserted on the charts and forms in this manual are applicable only to the individual aircraft, the serial number of which appears on the title page and on the various forms and charts. Weight and balance control of Naval Aircraft is further promulgated by NAVAIR 01-1B-50, Military Specifications MIL-W-25140, Weight and Balance Control Data (for airplanes and rotorcraft) and OPNAVINST 4790.2. This manual is to remain with the aircraft and under the custody of the Weight and Balance Officer or the controlling custodian of the aircraft. If the aircraft is to be deployed or separated from the controlling custodian for an extended period of time, the Weight and Balance Officer shall copy and retain the latest Chart C from the handbook, in the event the handbook is lost during the separation.

1-2. The charts and forms referred to herein may differ in nomenclature and arrangement from those shown in previously published copies of this manual since the charts are revised from time to time; however, the general principle of use will not change.

1-3. CHARTS AND FORMS. The system of field weight and balance control requires the use of several different charts and forms. They are identified as follows:

a. DD FORM 365 - Record of Weight and Balance Personnel.

b. Chart A (DD Form 365-1) - Basic Weight Check List.

c. DD Form 365-2 - Airplane Weighing Record.

d. Chart C (DD Form 365-3) - Basic Weight and Balance Record.

e. Chart E - Consists of Loading Data, Charts, Graphs, and weighing procedures supplied by the prime contractor for a specific model aircraft.

f. Form F (DD Form 365-4) - Weight and Balance Clearance.

1-4. RESPONSIBILITIES. The aircraft manufacturer inserts all identifying data on the title page of this manual and on the various charts and forms. He completes all charts, including sample weight and balance clearance Form F, if applicable, at time of delivery. All subsequent changes in weight and balance are compiled by weight and balance technicians in accordance with instructions contained herein and NAVAIR 01-1B-50.

1-5. The Type Commanders shall ensure that the aircraft custodians establish an effective system for weight and balance control of aircraft assigned to their command.

1-6. The aircraft reporting custodian shall ensure that:

a. Records of weight and balance for all assigned aircraft are current and maintained in the correct format.

b. The method of loading is satisfactory for safe flight, and the manual of weight and balance data is accurate.

c. Weight and balance data of modifications are properly utilized in updating aircraft records.

d. Form F (DD Form 365-4) for each administrative type Class 2 aircraft, including combat readiness training aircraft, for each loading arrangement that would normally be used are prepared and maintained.

NOTE

Each command shall determine the number of loading arrangements required, based on the mission of the aircraft involved.

NOTE

Check Form F (DD Form 365-4) every 90 days for accuracy (updating as required). If no change is involved, redate the form.

e. Responsibilities and requirements for the NARF's are explained in OPNAVINST 4790.2B Vol IV chapter 4-7.

1-7. AIRCRAFT CLASSES.

a. Class 1. Class 1 aircraft are those whose recommended weight or center of gravity (CG) limits sometimes can be exceeded by loading arrangements normally employed in tactical operations and, therefore, need loading control.

b. Class 2. Class 2 aircraft are those whose recommended weight or CG limits can readily be exceeded by loading arrangements normally employed in tactical operations and, therefore, need a high degree of loading control.

1-8. AIRCRAFT WEIGHINGS.

Are performed at each SDLM rework or:

a. As required by pertinent service directives.

b. When major modifications or repairs are made.

c. When the calculated weight and balance data are suspected to be in error.

d. When unsatisfactory flight characteristics are reported which cannot definitely be determined as improper aircraft loading or error in weight and balance data.

1-9. FLIGHT CLEARANCE REQUIREMENTS.

a. Weight and balance clearance (DD Form 365-4) is mandatory for all flights of Class 2 aircraft except student training flights. These exceptions are permitted only when the training officer maintains weight and balance control of aircraft used for student cadet training.

b. Weight and balance clearance is required for Class 1 aircraft, but the DD Form 365-4 may be reused until the Basic Weight or CG changes (See paragraph 3-9).

1-10. SUPPLY OF FORMS.

Forms prescribed in this manual may be requisitioned through normal distribution channels. Use DD Form 1348.

1-11. USER COMMENTS.

Changes or corrections to the body of the NA 01-1B-40 Technical Manual, Weight and Balance Data, are made through the normal technical manual change procedure. However if corrections or changes are required for the Charts A and E which are contained within the NA 01-1B-40, contact NAVAIR, AIR-5222. NAVAIR is responsible for making corrections and/or updating them in the most appropriate manner.

SECTION II
DEFINITIONS

2-1. DEFINITIONS.

a. Use of "Shall," "Will," "Should" and "May."

(1) Whenever the words "shall" or "will" appear, it shall be construed to mean the requirements are mandatory.

(2) The word "should" is used to indicate a nonmandatory desire or preferred method of accomplishment.

(3) The word "may" is to indicate an acceptable or suggested means of accomplishment.

b. Basic Weight. The basic weight of an aircraft includes all fixed operating equipment, all oils, and unusable fuel to which it is only necessary to add the variable or expendable load items for the various missions.

NOTE

The basic weight of an aircraft varies with structural modifications and changes in the fixed operating equipment. The term "basic weight," when qualified with a word indicating the type of mission, such as "basic weight for combat" or "basic weight for ferry," may be used in conjunction with directives stating what the equipment shall be for these missions. For example, extra fuel tanks and various items of equipment installed for long range ferry flights which are not normally carried on combat missions shall be included in "basic weight for ferry" but not in "basic weight for combat."

c. Operating Weight. The operating weight of an aircraft is the basic weight plus those variable items which remain substantially constant for the type mission. These items include crew, crew's baggage, steward's equipment, emergency and extra equipment that may be required.

NOTE

In the case of transport aircraft, the operating weight is the weight of the aircraft including the crew and all equipment required for the mission but not including fuel or payload.

d. Gross Weight. The gross weight is the total weight of an aircraft and its contents.

(1) Takeoff Gross Weight. The takeoff gross weight is the operating weight plus the variable and expendable load items which vary with the mission. These items include fuel, water injection fluid, JATO or RATO, cargo, passengers, ammunition, bombs, rockets and external auxiliary fuel tanks if to be disposed of during flight.

(2) Landing Gross Weight. The landing gross weight is the takeoff gross weight minus the expended load items.

e. Tare. The tare is the weight of equipment necessary for weighing the aircraft, chocks, blocks, slings and jacks, which is included in the scale readings or reactions, but is not a part of the aircraft weight.

2-2. BALANCE DEFINITIONS.

a. Reference Datum. The reference datum is an imaginary vertical plane at or near the nose of the aircraft from which all horizontal distances are measured for balance purposes. Diagrams of each aircraft show this reference datum as balance station zero (see figure 2-1).

b. Arm. For balance purposes, the arm is the distance in inches from the reference datum to the center of gravity of the item. Arms may be determined from the aircraft diagram in Chart E.

c. Moment. The moment is the weight of an item multiplied by its arm. Moment divided by a constant is generally used to simplify balance calculations by reducing the number of digits.

NOTE

For most aircraft it will be found that inches and moment/1000 have been used by the aircraft manufacturer on Chart A and E for basic weight data on Chart C. For some extremely small aircraft it may be found that moment/100 has been used. For some extremely large aircraft, it may be found that arms in feet or possibly moment/10,000 have been used. In any event for a given aircraft the same units of dimensions for arm and the same moment/constant must be used consistently for any revisions or additions to Charts A, C and E.

d. Average Arm. The average arm is obtained by adding the weights and adding the moments of a number of items and dividing the total moments by the total weight.

e. Basic Moment. The basic moment is the sum of the moments of all items making up the basic weight. When using data from an actual weighing of an aircraft, the basic moment is the total moment of the basic aircraft with respect to the reference datum.

f. Center of Gravity (CG). The center of gravity is the point about which an aircraft would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the aircraft.

g. Center of Gravity Limits. The CG limits are the extremes of movement which the CG can have without making the aircraft unsafe to fly. The CG of the loaded aircraft must be within these limits at takeoff, in the air and on landing. In some cases, separate takeoff and landing limits may be specified.

h. Balance Computer Index. The balance computer index is a number representing the moment, which when considered in conjunction with the weight gives the CG position.

i. Mean Aerodynamic Chord (MAC). Mean aerodynamic chord is an engineering term which represents an airfoil's chord in aircraft design. It is a constant length which is also used in the calculation of center of gravity location in terms of percent MAC.

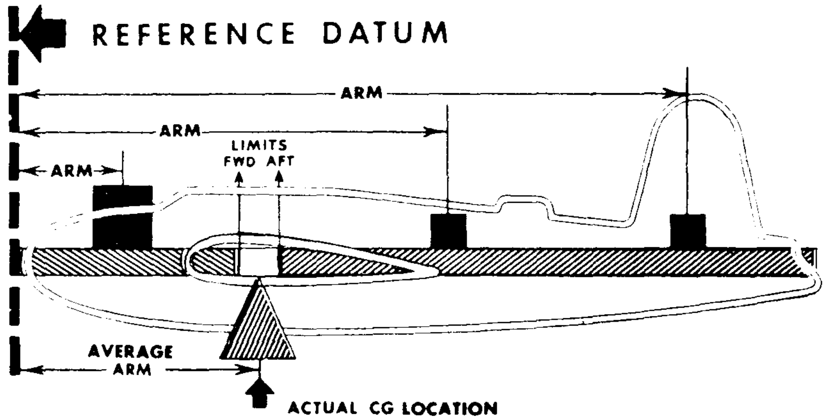


Figure 2-1. Reference Datum

SECTION III
INSTRUCTIONS FOR USE OF FORMS AND CHARTS

3-1. GENERAL. There are two parts to the weight and balance problem. First, one must have correct information as to the basic weight and moment. Second, gross weight and balance must be maintained within weight and CG limits with the addition of load. The first part is controlled by Charts A and C after the basic weight and balance have been determined by weighing the aircraft. The second part is carried out on Form F with the aid of a balance computer or Chart E.

NOTE

The manual and completed forms shall take on the security classification of Charts A, C and E of the aircraft for which they are used.

3-2. RECORD OF WEIGHT AND BALANCE PERSONNEL (DD FORM 365). Listed at the top of the form are the aircraft model and serial number. The form provides a continuous record of the name and qualifications of civilian or military weight and balance personnel responsible for the manual records, the station, the date assigned/the date relieved. All entries shall be complete and legible.

3-3. PRELIMINARY WEIGHING INSTRUCTIONS.

a. Assemble the necessary equipment, including scales, hoisting equipment, jacks, cribbing, leveling bars, and level, measuring tape, plumb bobs and string as required. Weighings shall be performed on platform type scales. Non-platform type weighings require specific written permission from NAVAIR (Code 5222).

b. Remove dirt, grease and moisture from the aircraft.

c. Drain fuel from the tanks with the aircraft in its normal attitude on the ground. (If impractical to drain due to special considerations, obtain permission from AIR-5222 for a full fuel weighing. Fill the system to capacity. Since the weight of the fuel varies with temperature, determine actual weight per gallon by use of a hydrometer. Multiply by gallons capacity, obtained from Chart E, for total fuel weight. Never weigh with partially filled tanks.)

d. Drain oil tanks or fill to normal operating capacity.

e. Fill reservoirs for drinking and washing water, hydraulic, anti-icing and cooling fluids, to normal level.

f. Inflate or deflate main and nose or tail landing gear oleo struts to level the aircraft. (Some aircraft must be weighed unlevel. Their Chart E will contain the appropriate weighing instructions).

g. Conduct an inventory of the equipment actually installed in the aircraft. This shall be accomplished on Chart A, Basic Weight Check List.

NOTE

A basic weight without the corresponding inventory is of no value to the activity receiving the aircraft.

h. Release the brakes before the aircraft is placed on the scale to reduce the possibility of side and thrust loads on the scales. Side or thrust loads can cause erroneous weighing results.

NOTE

The aircraft must be weighed in a closed hangar (no air movement). The slope of floor shall not exceed 1/4 inch in one foot.

3-4. AIRPLANE WEIGHING RECORD (DD FORM 365-2.

a. Fill identifying data and enter the actual scale readings in the first column.

b. Subtract tare from the scale readings to obtain the net weight.

c. Measure dimensions B and D during the weighing. Using these dimensions and the location of the jig point, determine arms E and F from the measurements recorded. For checking purposes, only approximate dimensions are normally listed on Chart E. Be sure to read the measuring tape graduations correctly. The tape may be graduated in feet and inches, or feet and tenths of feet.

d. Multiply the sub-total net weight of the main wheels and the net weight of the nose or tail wheel by dimensions E and F to obtain their moments.

e. Add the net weights and moments of the main wheels and nose or tail wheel to obtain the total net weight and total moment.

f. Divide the total moment by the total net weight to obtain the "As Weighed" Arm (CG position) in inches from the reference datum (H).

g. Transfer the Total "As Weighed", Weight, Arm, and Moment to the back of the weighing form.

h. Do not subtract the oil weight and moment from the total "As Weighed". After Jan 1, 1982, oil became part of the Basic Weight, and the "Oil" line on the DD 365-2 form should be ignored.

i. Enter in Column I the weight and moment of items which were aboard the aircraft when it was weighed but which are not part of basic weight.

NOTE

"Items weighed but not part of basic weight" would be items that are normally listed in Chart E. If the item is listed in Chart A, it is part of the basic weight.

j. Enter the in Column II weight and total moment of items which are part of basic weight but which were not aboard the aircraft when it was weighed. If the aircraft is weighed after overhaul with a completely dry fuel or oil system, include unusable fuel and full oil in Column II.

NOTE

Trapped fuel is the fuel left on board after the aircraft has been drained. It may be more or less than the unusable fuel which is obtained by running the system dry by running the engines. Basic weight is defined as having unusable fuel on board. It may be necessary to subtract "trapped fuel" via Column I and add "unusable fuel" on Column II to obtain a correct "basic weight".

k. From the Total (as weighed) weight and moment, subtract the total weight and moment from Column I and add the total weight and moment from Column II to obtain the airplane basic weight and moment.

l. Enter the new basic weight and moment/constant on Chart C. (DD 365-3) (All subsequent aircraft loadings shall be based on the latest figures entered on Chart C.)

m. Fill in the reaction locations and type of scales used.

n. Include under Remarks information as to the attitude of the aircraft when weighed.

3-5. CHART A-BASIC WEIGHT CHECK LIST (DD FORM 365-1). The Basic Weight Check List is a tabulation of all operating equipment that is or may be installed and for which provision or fixed stowage has been made in a definite location in the aircraft. It gives the weight, arm and moment/constant of the individual items for use in adjusting an "as weighed" weight and moment to a basic weight and moment, and for correcting the basic weight and moment on Chart C as changes are made in this equipment. When check marks are entered in the "In Aircraft" column, it serves as the inventory of equipment in the Basic Weight and moment/constant. The chart should be checked and updated whenever:

a. The aircraft is received at a new base (custodian change).

b. Modification or structural changes are made.

c. The aircraft has a major overhaul or is repaired.

d. Changes in equipment are made for a different type of operation or mission.

e. A pilot reports unstable flight characteristics.

f. The aircraft is weighed.

3-6. USE OF CHART A (SEE FIGURE 3-1). The manufacturer of the aircraft shall place check marks in the first column and mark that column "Delivery Equipment" to identify the items of equipment in the aircraft for the delivery condition. This delivery inventory shows equipment included in the initial Basic Weight entry on Chart C. Subsequent check list inventories shall be carried on as follows:

a. Inspect the aircraft for equipment actually installed, placing check marks in the next unused "In Aircraft" column. A check in the column headed "In Aircraft" indicates the presence of the item in the aircraft on the date at the head of the column, and a zero indicates its absence. Items shall not be checked unless they are installed, and items marked zero are not included in the Basic Weight and balance tabulated on Chart C for the corresponding date. During this inventory, note whether any new items of equipment which are not listed in Chart A have been installed and, if so, add the item by entering on Chart A the next sequential item number and the name or description of the item, together with the date in parentheses and followed by the weight, arm, and moment/constant.

b. Compare this inventory with that under the last Check heading, noting any changes in the items of equipment installed in the aircraft. Refer to Chart C to ascertain whether the necessary weight and moment corrections have been

FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM-55-405-9

CHART A – BASIC WEIGHT CHECK LIST RECORD

PAGE 1 OF 10 PAGES | MODEL DESIGN: SAMPLE | SERIAL NUMBER: SAMPLE

RECORD OF CHECKING *(Enter Date) (YYMMDD)*

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION *(Grouped by compartment)*	WEIGHT	ARM	MOMENT/ ENTER CONSTANT	1 IN AIRCRAFT	1 CHART C ENTRY	2 IN AIRCRAFT	2 CHART C ENTRY	3 IN AIRCRAFT	3 CHART C ENTRY	4 IN AIRCRAFT	4 CHART C ENTRY	5 IN AIRCRAFT	5 CHART C ENTRY	6 IN AIRCRAFT	6 CHART C ENTRY	7 IN AIRCRAFT	7 CHART C ENTRY	8 IN AIRCRAFT	8 CHART C ENTRY	9 IN AIRCRAFT	9 CHART C ENTRY
A	NOSE COMPARTMENT (0-93 in.)																					
A-1	(2) 50 CAL NOSE TURRET GUNS AND ACCESSORIES	146	13	1.1	✓																	
A-2	NOSE TURRET (INCL. 21 LB. ARMOR)	416	13	5.4	✓																	
A-3	BOMBSIGHT	32	41	1.3	✓																	
A-4	STABILIZER	44	41	1.8	✓																	
A-5	BOMBSIGHT HEATER PAD	6	41	0.2	✓	✓																
A-6	BOMBER'S KNEE PAD	7	70	0.5	✓																	
A-7	FIRE EXTINGUISHER, TYPE 2	7	81	0.6	✓																	
A-8	DRIFTMETER AND MOUNT	23	84	1.9	0	✓																
~~A-9~~	~~GUNNER'S ARMOR PLATE~~	~~70~~	~~90~~	~~6.3~~	✓																	
A-10	GUNNERS FLAK CURTAIN (6-1-71)	12	90	1.1																		

DD FORM 365-1, 62 JAN — REPLACES DD FORM 365A, SEP 54, WHICH WILL BE USED

(1) A check mark in the "IN AIRCRAFT" column indicates that the item is still installed. No check mark is required in the "CHART C ENTRY" column.

(2) A check mark in the "IN AIRCRAFT" column indicates the presence of the item. In this instance it indicates the installation of an item not previously installed. A check mark in the "CHART C ENTRY" column indicates that a corresponding correction of Chart C has been made.

(3) A zero in the "IN AIRCRAFT" column indicates the absence of the item at the time of this inventory. In this instance, it indicates the removal of an item previously installed. A check mark in the "CHART C ENTRY" column indicates that a corresponding correction of Chart C has been made.

(4) If an item is permanently removed from the aircraft, delete it by drawing a line through the Chart A entries.

(5) If a new item is installed, enter item number, name or description (including the date in parenthesis following the description), and make corresponding entry on Chart C.

Figure 3-1. Chart A - Basic Weight Check List made. If so, place check marks opposite such items in the "Chart C Entry" column. If not, correct the basic weight and moment/constant data on Chart C and then enter the "Chart C Entry" column check marks.

c. Check marks are made only at the time of a complete inventory. Never change the check marks or add new ones under a previously accomplished check heading. Use the next Check column. When an inventory is included as part of a weighing, the procedure outlined in the preceding paragraph should not be omitted since this correction makes possible the comparison of calculated and actual weight figures. Check marks in the "Chart C Entry" column shall indicate only a calculated change in the Chart C Basis weight numbers.

d. Make sure that the date on which inventory is taken is entered over the check heading on Chart A and the same date entered in the date column on Chart C for the corresponding corrected Basic Weight and moment/constant.

3-7. CHART C - BASIC WEIGHT AND BALANCE RECORD (DD FORM 365-3).

a. General. Chart C is a continuous history of the Basic Weight, moment and balance computer index resulting from structural and equipment changes in service. At all times the last weight, moment/constant and index (if balance computer is applicable) are considered the current weight and balance status of the basic aircraft. The basic index for the balance computer can be determined by means of the index scale or index formula on the computer.

b. Use of Chart C (See figure 3-2).

(1) At time of delivery of a new aircraft, the manufacturer entered on this chart the basic weight, moment/constant and index of the aircraft. The itemized list of equipment included therein is shown and checked on Chart A in the Delivery Equipment column.

(2) Make additions or subtractions to the basic weight and moment on Chart C:

(a) Whenever equipment is added to or removed from the aircraft. If the item is listed on Chart A, enter the identical item number, description and applicable weight, arm and moment data on Chart C. If the item is not listed on Chart A, determine its actual weight and arm and record this information on both Chart A and Chart C.

NOTE

Do not enter check marks on Chart A for these items until a complete inventory is made but enter the date in parentheses following the description.

(b) Whenever a complete inventory reveals equipment changes not previously recorded, correct Charts A and C as required in paragraph 3-15.1. Date the newly calculated basic weight and moment to correspond with the date entered at the head of the Check column on Chart A identifying the new equipment content. It is also helpful to record on Chart C the "Check" column of Chart A which substantiates this new basic weight and moment.

(c) Whenever structural changes (i.e., airframe changes) are made in the aircraft. If the structural changes are provisions for equipment, list them separately from the equipment in Chart C. Structural changes should not be entered on Chart A since they become part of Basic Weight and are not readily removable.

CHART C – BASE WEIGHT AND BALANCE RECORD

(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T.O. 1-1B-40 NAVAIR 01-1B-40 AND TM 55-405-9

MODEL DESIGN: XYZ-2 | SERIAL NUMBER: 123457 | PAGE NUMBER: 1

DATE (YYMMDD)	ITEM NUMBER		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						CURRENT TOTAL BASIC AIRCRAFT		
				ADDED (+)			REMOVED (-)					
	IN	OUT		WEIGHT	ARM (in.)	MOMENT[1] 1,000	WEIGHT	ARM (in.)	MOMENT[1] 1,000	WEIGHT	MOMENT[1] 1,000	INDEX[2]
3-27-71			Delivery									
4-13-71			A-19 Nose Turret Provision							38,777	11,202	54.0
		✓	Structure Removed				215	23.7	5.1			
	✓		Structure Added	207	37.2	7.5						
			Navigator Relocation									
		✓	Minor items removed				32	78	2.5			
	✓		Minor items added	30	226.7	6.8						
		✓	Structure removed				16	68.7	1.1			
	✓		Structure Added	24	195.8	4.7						
	✓		B-4 PROV. For Additional Bomb Racks	13	161.5	2.1						
			TOTALS	274	77.	21.1	263	33.1	8.7	38,788	11,214	55.0
5-1-71	A-5		BOMB HEATER PAD	6.	1	.2				38,794	11,214	55.0
		A-8	Driftmeter and mount				23	84	1.9	38,771	11,212	55.4
5-5-71			Calculated Basic (Check Column No. 1)							38,771	11,212	55.4
5-5-71			As weighed (Check Column No. 1)							38,814	11,215	54.5
5-10-71		A-9	Gunners Armor Removed Permanently (T. D. NO. - - -)				70	90	6.3	38,744	11,209	55.8
6-1-71	A-10		Gunners Flak Curtain (T. D. NO. - - -)	12	90	1.1				38,756	11,210	55.6

EXAMPLE

[1] Enter constant used below line. [2] Load adjuster index.

DD FORM 82 JAN 365-3 REPLACES DD FORM 365C, SEP 54, WHICH WILL BE USED

Figure 3-2. Chart C - Basic Weight and Balance Record

(d) Whenever the aircraft is reweighed. Before weighing, make a complete inventory and bring the calculated Chart C figures up-to-date so that there is a basis for checking the actual weighing. Enter the new actual weighing Basic Weight and moment from the Airplane Weighing Record.

(3) Any change or modification which is caused by a specific order should carry a reference to the order number and date which authorized the change.

NOTE

The date entered on Chart C must be consistent with the Delivery Date or the date entered on the top of a "Check" column on Chart A and with the date on the Aircraft Weighing Record if used, or the date of the modification.

3-8. CHART E - LOAD DATA

a. The loading data on Chart E are intended to provide information necessary to weigh the aircraft and to work a loading problem for the aircraft to which this manual is applicable. Chart E is prepared by the Prime Contractor for a specific Aircraft, the content in this chart for each aircraft is governed by AIR-5222. The balance computer accomplishes the same purpose and requires less computation.

b. From the loading graphs, or tables, weight and moment/constant are obtained for all variable load items and are added arithmetically to the last current basic weight and moment/constant entered from Chart C to obtain the gross weight and moment. The CG of the loaded aircraft is represented by the intersection of the gross weight and moment lines on the CG graph or by a moment/constant figure if tables are used. If the aircraft is loaded within the forward and aft CG limits, the intersection will fall between the limiting CG lines on the CG graph. If a table is used, the moment/constant figure will fall numerically between the limiting moments/constants. The effect of the expenditure in flight of such items as fuel and bombs on the CG may be checked by subtracting the weights and moment/constant of such items from the takeoff gross weight and moment/constant and replotting on the CG graph or checking the new moment/constant with the CG table. This check should be made to determine whether or not the CG will remain within limits during the entire flight.

c. With the advent of inexpensive electronic calculators it is easier to obtain an aircraft's CG by direct calculation than by use of the tables or load adjuster slide rules. Sum the weights and moments/constants as before but divide the total moment/constant by the gross weight and multiply the result by the constant used in "Moment/Constant". The resulting number is the arm, or distance in inches, to the CG. If the CG limits are expressed as percents of mean aerodynamic chord (MAC), obtain the CG as a percent of MAC by subtracting the fuselage station of the leading edge of the MAC from the arm and dividing the result by the length of the MAC and then multiplying by 100.

3-9. WEIGHT AND BALANCE CLEARANCE FORM F (DD FORM 365-4).

a. General.

(1) Form F is the summary of the actual disposition of load in the aircraft for a particular flight. It records the balance status of the aircraft step by step. It serves as a work sheet on which the weight and balance technician records the calculations and

any corrections that must be made to ensure the aircraft will be within weight and CG limits throughout the flight. Weight and Balance class 2 aircraft require a new Form F for every flight. For class 1 aircraft, a Form F representing a particular loading may be used again if the aircraft's basic weight or CG hasn't changed. The Form F's must be checked and validated at least every 90 days to ensure that the loading information remains current.

(2) Form F is expendable and can be replaced when exhausted. An original and carbon are prepared for each loading. The original sheets, carrying the signature of responsibility, can be removed to serve as certificates of proper weight and balance as required by existing clearance directives. The duplicate copy must remain in the aircraft for the duration of the flight. On a cross-country flight this form aids the weight and balance technician at refueling bases and stopover stations. There are two versions of this form, Transport and Tactical, designed to provide for loading arrangements of these aircraft. It will be noted that the general use and fulfillment of either version is the same, although specific instructions for filling out each version are given herein. The choice of which version to use in the case of a bomber used to transport items, or of a cargo ship armed for protection, is the responsibility of the weight and balance technician at the takeoff base.

b. Use of Form F.

(1) Transport Aircraft (See figure 3-3).

(a) Insert the necessary information at the top of the form. In the blank spaces of the limitations table, enter the gross weight and CG restrictions obtained from the latest applicable Technical Order (NATOPS Manual).

(b) Ref 1. Enter the aircraft basic weight and index or moment/constant. Obtain these figures from the last entry on Chart C - Basic Weight and Balance Record.

NOTE

If a balance computer is used in loading the aircraft, enter opposite Ref 1 the index figure obtained from Chart C and use index figures throughout the form. Enter plate number of the computer in the computer plate number block. If Chart E is used instead of a balance computer, enter moment/constant values throughout the form.

(c) Ref 2. Do not enter the amount and weight of oil. On Jan 1, 1982, oil became part of the aircraft's basic weight.

NOTE

The moment/constant of items Ref 3 thru 7 may be obtained by multiplying the weight of the item times the arm of the compartment in which it is located, divided by the constant.

(d) Ref 3. Enter the number and weight of crew. Use actual crew weights if available.

(e) Ref 4. Enter the weight and moment/constant of the crew's baggage.

(f) Ref 5. Enter the weight and moment/constant of the steward's equipment.

WEIGHT AND BALANCE CLEARANCE FORM F – TRANSPORT (USE REVERSE FOR TACTICAL MISSIONS)			FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM 55-405-9
DATE (YYMMDD) 72-09-01	AIRCRAFT TYPE XYZ-2	FROM NAS JAX	HOME STATION NAS JAX
MISSION COURIER RUN	SERIAL NO 123457	TO NAS NORVA	PILOT LCDR COE

REMARKS

WING TANKS
C.S. 300 GAL.

LOAD ADJUSTER NUMBER

REF	ITEM	WEIGHT	INDEX OR MOM
1	BASIC AIRCRAFT (From Chart C)	19350	37.0
2	OIL (Gal)		
3	CREW (No) 4	680	25.4
4	CREW'S BAGGAGE	100	24.1
5	STEWARD'S EQUIPMENT		
6	EMERGENCY EQUIPMENT		
7	EXTRA EQUIPMENT		
8			
9	OPERATING WEIGHT	20505	24.1
10	TAKEOFF FUEL 700 (Gal)	4200	23.1
11	WATER INJ	113	23.0
12	TOTAL AIRCRAFT WEIGHT	24818	23.0

CORRECTIONS MOST FWD MOST AFT

COMPT OR ARM	ITEM	CHANGES (+ or −) WEIGHT	INDEX OR MOM
K	CARGO	-300	53.2
A	CARGO	+100	51.2
F	CARGO	+200	54.2
	M		
TOTAL WT REMOVED		-300	−
TOTAL WT ADDED		+300	+
NET DIFFERENCE		0	54.2

13 DISTRIBUTION OF ALLOWABLE LOAD (PAYLOAD)

PASSENGERS NO	PASSENGERS WEIGHT	COMPT OR ARM	CARGO	CARGO	COMPT OR ARM	WEIGHT (ZERO FUEL WT)	INDEX OR MOM (ZERO FUEL WT INDEX OR MOM / ZERO FUEL % MAC)
		A					
		B					
		C					
8	1360	D				1360	18.1
8	1360	E				1360	26.4
2	340	F				340	31.5
2	340	G	610			950	53.2
		H					
		I					
		J					
		K					
		L					
		M					
		N					
		O					
		P					
		FWD					
		AFT		300	K	300	62.2

EXAMPLE

LIMITATIONS

CONDITION	TAKEOFF	LANDING	FUEL
ALLOWABLE GROSS WEIGHT	31300	27500	26500
TOTAL AIRCRAFT WEIGHT (Ref 12)	24818		
Ref 9 + (Ref 23)		20905	
OPERATING WEIGHT (Ref 9)			20505
ALLOWABLE LOAD (Ref 13) (use smallest figure)	6482	6595	5995

(Zero Fuel or Limiting Wing Fue.

	FORWARD	AFT
PERMISSIBLE C G TAKEOFF	6	28
PERMISSIBLE C G LANDING	6	28
PERMISSIBLE C G ZERO FUEL WT		

REF	ITEM	WEIGHT	INDEX OR MOM
14			
15			
16	TAKEOFF CONDITION (uncorrected)	29128	62.2
17	TAKEOFF C G IN % M A C OR IN		
18	CORRECTIONS (if required)		54.2
19	TAKEOFF CONDITION (corrected)	29128	54.2
20	TAKEOFF C G IN % M A C OR IN	26.4	
21	ZERO FUEL WT	3800	55.9
22	LESS AIR DROP LOAD	113	
23	ESTIMATED LANDING FUEL	400	92.8
24	ESTIMATED LANDING CONDITION	25215	56.0
25	ESTIMATED LANDING C G IN % M A C OR IN	26.8	

COMPUTED BY SIGNATURE John Roe, LT USN

WEIGHT AND BALANCE AUTHORITY SIGNATURE Charles Doe, LTJG U.S.N.

PILOT SIGNATURE Allen Coe, LCDR U.S.N

DD FORM 365-4, 82 JAN — REPLACES DD FORM 365F, SEP 54, WHICH WILL BE USED

Figure 3-3. Weight and Balance Clearance Form F - Transport

(g) Ref 6. Enter the weight and moment/constant of emergency equipment.

(h) Ref 7. Enter the weight and moment/constant of any extra equipment.
Skip Ref. 8

(i) Ref 9. Enter the sum of the weights and moments/constant for Ref 1 thru Ref 7 inclusive, to obtain the Operating Weight and moment/constant.

(j) Ref 10. Enter the number of gallons and weight of the takeoff fuel. The weight of fuel used in warm-up and/or taxi will not be included.

NOTE

List under Remarks the fuel tanks concerned and the amount of fuel in each tank. If external or bomb bay fuel is carried, make appropriate entries to that effect in the spaces provided.

(k) Ref 11. Enter the number of gallons, weight and moment/constant of the water injection fluid.
XXXX

(l) Ref 12. Enter the sum of the weights and moments/constant for Ref 9 thru 11, inclusive, to obtain Total Aircraft Weight.

(m) Determine the Allowable Load based on takeoff, landing or limiting wing fuel restrictions by use of the Limitations table in the upper lefthand corner of the form, as follows:

1 Enter the Allowable Gross Weight for Takeoff and Landing. For Aircraft which have a gross weight restriction above which all weight must be fuel in the wings (e.g., an allowable zero wing fuel gross weight), enter Allowable Gross Weight for Limiting Wing Fuel in the last column of the Limitations table.

CAUTION

For those aircraft whose "ALLOWABLE GROSS WEIGHT" is limited by a taxiing and ground handling gross weight, subtract the warm-up and/or taxi fuel from maximum ground handling gross weight permissible and enter this figure in the "ALLOWABLE GROSS TAKE-OFF" block of the "LIMITATIONS" table. An appropriate entry will be entered in the "REMARKS" block noting this limiting factor.

2 Enter the Total Aircraft Weight from Ref 12. Estimate the fuel to be aboard at time of landing and enter the Operating Weight from Ref 9 and Operating Weight Plus Estimated Landing Fuel Weight.

3 Subtract the above weights from the respective allowable gross weights to obtain the respective Allowable Loads. The smallest of these figures is the Allowable Load and represents the maximum amount of weight which may be distributed throughout the aircraft in various compartments without exceeding the limiting gross weights of the aircraft.

(n). Ref 13. Using the same compartment letter designation as shown on the back of the balance computer or on Chart E, enter the number and weight of passengers, cargo, and mail. Use actual passenger weights if available. Enter the total for each compartment in the Weight column. If desired for statistical purposes, the Total Cargo and Total Mail weights may also be listed in the space provided under Remarks.

NOTE

The sum of the compartment totals must not exceed the Allowable Load determined in the Limitations table.

(o) Ref 16. Enter the sum of Ref 12 and the Compartment totals under Ref 13 opposite Takeoff Condition (Uncorrected). Calculate and enter the index or moment/constant for Ref 1 thru Ref 16, inclusive.

(p) Check the weight figure, Ref 16, against the Gross Weight Takeoff in the Limitations table. Check the index or moment/constant figure opposite Ref 16 by means of the balance computer or Chart E to ascertain that the indicated CG is within allowable limits or calculate the CG as explained in paragraph 3-17.3.

(q) If changes in amount or distribution of load are required, indicate necessary adjustments by proper entries in the Corrections table in lower left hand corner of the form. Enter a brief description of the adjustment made in the column marked Item. Add all the weight and moment decreases and insert the totals in the space opposite Total Weight Removed. Add all the weight and moment increases and insert the totals in the space opposite Total Weight Added. Subtract the smaller from the larger of the two totals and enter the difference (with applicable + or - sign) opposite Net Difference. If a balance computer is used, the revised index for each correction item is entered. Transfer the Net Difference figures to the spaces opposite Ref 18.

(r) Ref 17. By referring to CG table on Chart E, or to CG grid on the balance computer, or by calculation, determine the takeoff CG position. Enter this figure in the space provided opposite Takeoff CG.

(s) Ref 19. Enter the sum of, or the difference between, Ref 16 and Ref 18. Re-check to assure that these figures do not exceed allowable limits.

(t) Ref 20. By referring to CG table on Chart E, or to CG grid on the balance computer, or by calculation determine the takeoff CG position. Enter this figure in the space provided opposite Takeoff CG.

(u) Ref 21. Estimate the weight of fuel which may be expended before landing. Enter this figure together with index or moment/constant in the spaces provided.

NOTE

Do not consider reserve fuel as expended when determining Estimated Landing Condition.

Ref 21 continued - Enter the weight of Air Supply load to be dropped before landing, with index or moment/constant. Enter the weight of Miscellaneous items to be expended before landing with index or moment/constant, and enter shift of crew to landing positions, with index or moment/constant change due to crew movement. Explain under Remarks if necessary.

(v) Ref 22. Enter the difference in weight and index or moment/constant between Ref 10 and Ref 21.

(w) Ref 23. Enter the difference in weights and index or moment/constant between Ref 19 and the total of Ref 21.

(x) Ref 24. By again referring to the CG table on Chart E or to CG grid on the balance computer, or by calculation determine the estimated landing CG position. Enter this figure opposite Estimated Landing CG.

(y) The necessary signatures must appear at the bottom of the form.

(2) Tactical Aircraft (see figure 3-4).

(a) Insert the necessary identifying information at the top of the form. In the blank spaces of the Limitations table enter the gross weight and CG restrictions obtained from the latest applicable technical orders. (NATOPS)

(b) Ref 1. Enter the aircraft basic weight and index or moment/constant. Obtain these figures from the last entry on Chart C - Basic Weight and Balance Record.

NOTE

If a balance computer is used in loading the aircraft, enter opposite Ref 1 the index figure obtained from Chart C and use index figures throughout the form. Enter plate number of the computer under Remarks. If Chart E is used instead of a balance computer, enter moment/constant values throughout form.

(c) Ref 2. Do not enter the amount and weight of oil.

NOTE

On Jan 1, 1982, oil became part of the aircraft basic weight.

(d) Ref 3. Using the compartment letter designations as shown on the back of the computer or on Chart E, enter the number and weight of the crew at their takeoff positions, baggage, cargo and miscellaneous items. Use actual crew weights and moments/constant if available. Enter the total of each compartment in the Weight column.

(e) Ref 4. Enter the sum of the weights and moments/constant for Ref 1 thru Ref 3 to obtain Operating Weight.

(f) Ref 5. Enter the compartment, number of rounds, caliber and weight and moments/constant of all ammunition.

(g) Ref 6. Enter the store designation, weights, and moments/constant of all bombs, torpedoes, and rockets.

(h) Ref 7. Enter the number of gallons and identify as built in, bomb bay, or external. Also, record the weight and moment/ constant of the fuel. If bomb bay or external fuel is carried, make appropriate entries in the space provided. In the event auxiliary fuel tanks are to be expended during flight, these items and their weight should also be entered as part of Ref 7.

(i) Ref 8. Enter the appropriate nomenclature, weight and moment/constant of any miscellaneous equipment.

WEIGHT AND BALANCE CLEARANCE FORM F – TACTICAL

(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM 55-405-9

DATE (YYMMDD) 01 Sept 72	AIRCRAFT TYPE XYZ-1	FROM NAS NORIS	HOME STATION NAS MOFFETT
MISSION TRAINING	SERIAL NO 123456	TO NAS MIRAMAR	PILOT LCDR A. COE

MOST FWD, MOST AFT, CORRECTIONS (Ref 11)

COMPT	ITEM	CHANGES (+ or –) WEIGHT	INDEX OR MOM
B	Cargo	-150	51.0
C	Cargo	+150	53.3
TOTAL WEIGHT ADDED		+ 150	+
TOTAL WEIGHT REMOVED		– 150	–
NET DIFFERENCE (Ref 11)		0	53.3

REMARKS

Fuel consumption sequence:
1. Bomb Bay - 300 gal.
2. Aux Wing - 500 gal.
3. Main Wing - 1000 gal.

Navigator will move to ditching station in compt. G for landing

REF		ITEM	WEIGHT	INDEX OR MOM
1		BASIC AIRCRAFT (From Chart C)	36481	46.1
2		OIL (Gal)		
3	DISTRIBUTION OF LOAD	COMPT / CREW NO. / CREW WEIGHT / CARGO/MISC		
		B / 3 / 540 / 150	690	36.8
		C / 1 / 180	180	35.3
		G / 1 / 180	180	38.0
4		OPERATING WEIGHT	37531	38.0
5	AMMO	COMPT A, 800RNDS, .50 CAL	240	33.5
		COMPT H, 1500RNDS, .50 CAL	450	42.9
		COMPT J, FLARE	150	49.4
6	BOMBS, MISSILES, ETC.		2000	45.9
7	FUEL	Built in - 1500 gal.	9000	50.5
		Bomb Bay - 300 gal.	1800	49.1
		External -		
8		MISC VARIABLES		
9		TAKEOFF CONDITION (uncorrected)	51171	49.4
10		TAKEOFF C.G. IN % M.A.C. OR IN		
11		CORRECTIONS (If required)	----	53.3
12		TAKEOFF CONDITION (corrected)	51171	53.3
13		TAKEOFF C.G. IN % M.A.C. OR IN	28.2	
14		TAKEOFF FUEL (1800 gal.)	10800	50.0
	LESS EXPENDABLES	BOMBS	2000	50.3
		AMMUNITION	690	45.4
		FUEL (1450 gal.)	8700	43.3
		NAVIGATOR, COMPT BTOG	----	47.2
		FLARE	150	49.4
15		ESTIMATED LANDING FUEL (350 gal)	2100	53.1
16		ESTIMATED LANDING CONDITION	39631	47.2
17		ESTIMATED LANDING C.G. IN % M.A.C. OR IN	25.7	

LIMITATIONS

GROSS WT. TAKEOFF (lb)	GROSS WT. LANDING (lb)
53000	40500

	FORWARD	AFT
PERMISSABLE C.G. TAKEOFF (% M.A.C. or in.)	28.0	33.0
PERMISSABLE C.G. LANDING (% M.A.C. or in.)	25.0	33.0

COMPUTED BY SIGNATURE: John Roe, LT U.S.N.

WEIGHT AND BALANCE AUTHORITY SIGNATURE: Charles Doe LTJG U.S.N.

PILOT SIGNATURE: Allen Coe, LCDR U.S.N.

DD FORM 365-4, 82 JAN — REPLACES DD FORM 365F, SEP 54, WHICH WILL BE USED

GPO : 1982 O - 374-417

Figure 3-4. Weight and Balance Clearance Form F - Tactical

(j) Ref 9. Enter the sum of the weights for Ref 4 thru Ref 8 opposite Takeoff Condition (Uncorrected). Calculate and enter the index or moment/constant for Ref 1 thru Ref 10, inclusive.

(k) Ref 10. By referring to the CG table on Chart E, by calculation, or by referring to the CG grid on the balance computor, determine the takeoff CG position. Enter this figure in the space provided opposite takeoff CG.

(l) Check the weight figure opposite Ref 9 against the Gross Weight Takeoff in the Limitations table. Check the index or moment/constant figure opposite Ref 9 by means of balance computer, Chart E, or calculate it by dividing the moment/constant by the weight and multiply the result by the constant to obtain the arm to the CG. The CG must be within allowable limits. If the CG limits are given as a percentage of the mean aerodynamic chord (MAC), the arm to the CG may be converted by subtracting the arm to the leading edge of the MAC (LE MAC), dividing the result by the length of the MAC and multiplying by 100.

(m) If changes in the amount or distribution of load are required, indicate necessary adjustments by proper entries in the Corrections table at the lower left side of the form. Enter a brief description of the adjustment made in the column marked Item. Add all the weight and moment decreases and insert the totals in the space opposite Total Weight Removed. Add all the weight and moment increases and insert the totals in the space opposite Total Weight Added. Subtract the smaller from the larger of the two totals and enter the difference (with applicable + or - sign) opposite Net Difference. If a balance computer is used, the revised index for each correction item is entered. Transfer these Net Differences figures to the spaces opposite Ref 11.

(n) Ref 12. Enter the sum of, or the difference between, Ref 9 and Ref 11. Re-check to assure that these figures do not exceed allowable limits.

(o) Ref 13. By referring to CG table on Chart E, by calculation, or by referring to the CG grid on the balance computer, determine the takeoff CG position. Enter this figure in the space provided opposite Takeoff CG.

(p) Ref 14. Estimate the weight of take off fuel, bombs, torpedoes, rockets, ammunition (not including weight of cases and links if retained), fuel (including auxiliary fuel tanks that are to be dropped), and any other items which may be expended before landing. Include in this item any shift of crew to landing positions. Enter figures together with index or moment/constant in the spaces provided.

NOTE

> Do not consider reserve fuel as expended when determining Estimated Landing Condition.

(q) Ref 15. Enter the difference in the sum of the weights and indexes or moments/constant of fuel in Ref 7 and the weight and index or moment/constant of expendable fuel in Ref 14. Enter number of gallons.

(r) Ref 16. Enter the differences in weights and index or moment/constant between Ref 12 and the total of Ref 14.

(s) Ref 17. By again referring to CG table on Chart E by calculations, or by referring to the CG grid on the balance computer, determine the estimated landing CG position. Enter this figure opposite Estimated Landing CG.

(t) The necessary signatures must appear at the bottom of the form.

SECTION IV

FORMS AND CHARTS

INDEX TO FORMS

RECORD OF WEIGHT AND BALANCE PERSONNEL		*FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM-55-405-9*		
MODEL/DESIGN		SERIAL NUMBER		
NAME *(Last, First, M.I.)*	WHERE AND WHEN QUALIFIED	STATION	DATE ASSIGNED *(YYMMDD)*	DATE RELIEVED *(YYMMDD)*

DD FORM 82 JAN 365 PREVIOUS EDITION WILL BE USED.

RECORD OF WEIGHT AND BALANCE PERSONNEL		*FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM 55-405-9*		
MODEL/DESIGN		SERIAL NUMBER		
NAME *(Last, First, M.I.)*	WHERE AND WHEN QUALIFIED	STATION	DATE ASSIGNED *(YYMMDD)*	DATE RELIEVED *(YYMMDD)*

FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM-55-405-9

CHART A – BASIC WEIGHT CHECK LIST RECORD

RECORD OF CHECKING *(Enter Date) (YYMMDD)*

PAGE OF PAGES	MODEL, DESIGN	SERIAL NUMBER

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION *(Grouped by compartment)*	WEIGHT	ARM	MOMENT/ ENTER CONSTANT	1		2		3		4		5		6		7		8		9	
					IN AIRCRAFT	CHART C ENTRY	IN AIRCRAFT	CHART C ENTRY	IN AIRCRAFT	CHART C ENTRY	IN AIRCRAFT	CHART C ENTRY	IN AIRCRAFT	CHART C ENTRY	IN AIRCRAFT	CHART C ENTRY	IN AIRCRAFT	CHART C ENTRY	IN AIRCRAFT	CHART C ENTRY	IN AIRCRAFT	CHART C ENTRY

DD FORM 82 JAN 365-1 REPLACES DD FORM 365A SEP 54, WHICH WILL BE USED

FORM B – AIRCRAFT WEIGHING RECORD		*FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40 AND TM-55-405-9*
DATE WEIGHED *(YYMMDD)*	MODEL/DESIGN	SERIAL NUMBER

PLACE WEIGHED	WEIGHT AND BALANCE TECHNICIAN *(Last, first, M.I.)*	DUTY PHONE NUMBER

REACTION *(Wheels, jackpoints, etc.)*	SCALE READING	TARE	NET WEIGHT	ARM	MOMENT
LEFT MAIN					
RIGHT MAIN					
SUB-TOTAL *(Both main)*				E	
NOSE OR TAIL				F	
TOTAL *(as weighed)* *Not to be posted on Chart C*					

MEASUREMENTS

B = ____________ the distance from the jig point, to the center line of the main reactions. Obtain by measurement.

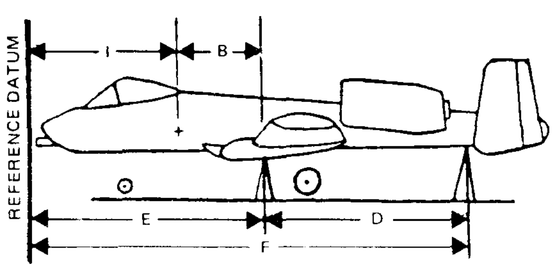
I = ____________ the distance from the reference datum to the jig point of the aircraft, from which a plumb bob can be dropped to the ground. Obtain from the aircraft diagram in Chart E.

E = ____________ [1] the distance from the reference datum to the center line of the main reactions.
E = I + B
E = I – B (If the jig point is aft of the center line of the main reactions.)

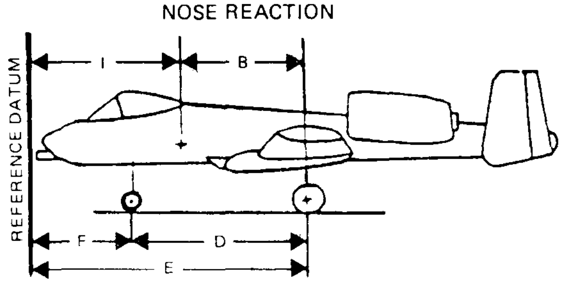
D = ____________ the distance between the main and nose or tail reaction. Obtain by measurement.

F = ____________ [1] the distance from the reference datum to the center line of the nose or tail reaction.
F = E – D (for nose reaction)
F = E + D (for tail reaction)

TAIL REACTION



NOSE REACTION



DIAGRAMS FOR MEASURING VARIOUS TYPES OF REACTIONS TO DETERMINE ARM OF SUPPORT POINTS.

[1] Check dimensions E and F against approximate dimensions listed in Chart E

DD FORM 62 JAN 365-2 REPLACES DD FORM 365B, SEP 54, WHICH WILL BE USED

DESCRIPTION	NET WEIGHT	ARM	MOMENT	INDEX OR MOM[1]
TOTAL *(As weighed)* *(From front side)*				
OIL IN AIRPLANE	–		–	
TOTAL OF ITEMS WEIGHED BUT NOT PART OF BASIC WEIGHT *(From Column I below)*	–		–	
TOTAL OF BASIC WEIGHT ITEMS NOT IN AIRCRAFT WHEN WEIGHED *(From Column II below)*	+		+	
BASIC AIRCRAFT *(Post to Chart C)*				

COLUMN I				COLUMN II			
ITEMS WEIGHED BUT NOT PART OF BASIC WEIGHT	WEIGHT	ARM	MOMENT	BASIC WEIGHT ITEMS NOT IN AIRCRAFT WHEN WEIGHED	WEIGHT	ARM	MOMENT
TOTAL				**TOTAL**			

REACTIONS USED

TYPE SCALE

SERIAL NUMBER

CALIBRATION DATE *(YYMMDD)*

CALIBRATED ACCURACY

REMARKS

[1] *Enter constant need.*

CHART C – BASE WEIGHT AND BALANCE RECORD

(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40 AND TM 55-405-9

MODEL/DESIGN/SERIES	SERIAL NUMBER	PAGE NUMBER

DATE *(YYMMDD)*	ITEM NUMBER		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						CURRENT TOTAL BASIC AIRCRAFT		
				ADDED (+)			REMOVED (−)					
	IN	OUT		WEIGHT	ARM	MOMENT[1]	WEIGHT	ARM	MOMENT[1]	WEIGHT	MOMENT[1]	INDEX[2]

[1] *Enter constant used below line.* [2] *Load adjuster index*

DD FORM 82 JAN 365-3 REPLACES DD FORM 365C, SEP 54, WHICH WILL BE USED.

CHART C — BASE WEIGHT AND BALANCE RECORD

(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40 AND TM-55-405-9

MODEL/DESIGN/SERIES	SERIAL NUMBER	PAGE NUMBER

DATE (YYMMDD)	ITEM NUMBER		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						CURRENT TOTAL BASIC AIRCRAFT		
				ADDED (+)			REMOVED (−)					
	IN	OUT		WEIGHT	ARM	MOMENT[1]	WEIGHT	ARM	MOMENT[1]	WEIGHT	MOMENT[1]	INDEX[2]

[1] *Enter constant used below*   [2] *Load adjuster index.*

☆ U.S. Government Printing Office: 1982—360-679/5638

WEIGHT AND BALANCE CLEARANCE FORM F – TACTICAL

(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM 55-405-9

DATE *(YYMMDD)*	AIRCRAFT TYPE	FROM	HOME STATION
MISSION	SERIAL NO	TO	PILOT

MOST FWD, MOST AFT, CORRECTIONS *(Ref. 11)*

COMPT	ITEM	CHANGES *(+ or –)* WEIGHT	CHANGES *(+ or –)* INDEX OR MOM
TOTAL WEIGHT ADDED		+	+
TOTAL WEIGHT REMOVED		–	–
NET DIFFERENCE *(Ref. 11)*			

REMARKS

LIMITATIONS

GROSS WT. TAKEOFF *(lb.)*	GROSS WT. LANDING *(lb.)*	
PERMISSABLE C.G. TAKEOFF *(% M.A.C. or in.)*	FORWARD	AFT
PERMISSABLE C.G. LANDING *(% M.A.C. or in.)*	FORWARD	AFT

COMPUTED BY SIGNATURE

WEIGHT AND BALANCE AUTHORITY SIGNATURE

PILOT SIGNATURE

REF	ITEM	WEIGHT	INDEX OR MOM.
1	BASIC AIRCRAFT *(From Chart C)*		
2	OIL *(Gal.)*		
3 DISTRIBUTION OF LOAD	COMPT / CREW NO. / CREW WEIGHT / CARGO/MISC		
4	OPERATING WEIGHT		
5 AMMO			
6 BOMBS, MISSILES, ETC.			
7 FUEL			
8	MISC. VARIABLES		
9	TAKEOFF CONDITION *(uncorrected)*		
10	TAKEOFF C.G. IN % M.A.C. OR IN		
11	CORRECTIONS *(If required)*		
12	TAKEOFF CONDITION *(corrected)*		
13	TAKEOFF C.G. IN % M.A.C. OR IN		
14	TAKEOFF FUEL		
LESS EXPENDABLES			
15	ESTIMATED LANDING FUEL		
16	ESTIMATED LANDING CONDITION		
17	ESTIMATED LANDING C.G. IN % M.A.C. OR IN		

DD FORM 82 JAN 365-4 REPLACES DD FORM 365F, SEP 54, WHICH WILL BE USED.

GPO : 1982 O - 374-417

WEIGHT AND BALANCE CLEARANCE FORM F — TRANSPORT

(USE REVERSE FOR TACTICAL MISSIONS)

FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM 55-405-9

DATE *(YYMMDD)*	AIRCRAFT TYPE	FROM	HOME STATION
MISSION	SERIAL NO	TO	PILOT

REMARKS

LOAD ADJUSTER NUMBER

REF	ITEM	WEIGHT	INDEX OR MOM
1	BASIC AIRCRAFT *(From Chart C)*		
2	OIL (*Gal.)*		
3	CREW *(No.)*		
4	CREW'S BAGGAGE		
5	STEWARD'S EQUIPMENT		
6	EMERGENCY EQUIPMENT		
7	EXTRA EQUIPMENT		
8			
9	OPERATING WEIGHT		
10	TAKEOFF FUEL (*Gal.)*		
11	WATER INJ.		
12	TOTAL AIRCRAFT WEIGHT		

CORRECTIONS: MOST FWD MOST AFT

13 DISTRIBUTION OF ALLOWABLE LOAD *(PAYLOAD)*

COMPT OR ARM	ITEM	CHANGES *(+ or −)* WEIGHT	CHANGES INDEX OR MOM	PASSENGERS NO.	PASSENGERS WEIGHT	COMPT OR ARM	CARGO	CARGO	COMPT OR ARM
TOTAL WT REMOVED									
TOTAL WT ADDED									
NET DIFFERENCE									

ZERO FUEL WT

ZERO FUEL WT INDEX OR MOM

ZERO FUEL % MAC

LIMITATIONS

CONDITION	TAKEOFF	LANDING	[1] FUEL
ALLOWABLE GROSS WEIGHT			
TOTAL AIRCRAFT WEIGHT *(Ref. 12)*			
(Ref. 9) + (Ref. 23)			
OPERATING WEIGHT *(Ref. 9)*			
ALLOWABLE LOAD *(Ref. 13)* *(use smallest figure)*			

[1] *Zero Fuel or Limiting Wing Fuel*

PERMISSIBLE C.G. TAKEOFF	FORWARD	AFT
PERMISSIBLE C.G. LANDING	FORWARD	AFT
PERMISSIBLE C.G. ZERO FUEL WT	FORWARD	AFT

COMPUTED BY SIGNATURE

WEIGHT AND BALANCE AUTHORITY SIGNATURE

PILOT SIGNATURE

REF	ITEM	WEIGHT	INDEX OR MOM
14			
15			
16	TAKEOFF CONDITION *(uncorrected)*		
17	TAKEOFF C.G. IN % M.A.C. OR IN		
18	CORRECTIONS *(If required)*		
19	TAKEOFF CONDITION *(corrected)*		
20	TAKEOFF C.G. IN % M.A.C. OR IN		
21	ZERO FUEL WT		
22	LESS AIR DROP LOAD		
23	ESTIMATED LANDING FUEL		
24	ESTIMATED LANDING CONDITION		
25	ESTIMATED LANDING C.G. IN % M.A.C. OR IN		

DD FORM 365-4, 82 JAN — REPLACES DD FORM 365F, SEP 54, WHICH WILL BE USED.

U.S. GOVERNMENT PRINTING OFFICE: 1984 - 705-023/A6681

TECHNICAL MANUAL

USN AIRCRAFT WEIGHT AND BALANCE CONTROL

N00140-80-D-0454

This publication is required for official use or for administrative or operational purposes only. Distribution is limited to U.S. Government agencies. Other requests for this document must be referred to Commanding Officer, Naval Air Technical Services Facility. 700 Robbins Avenue, Philadelphia. PA 19111.

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1 APRIL 1983

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for original and changed pages are:

Original . . 0 . . 1 Apr 83

Total number of pages in this manual is 66 consisting of the following:

Page No.	# Change No.	Page No.	# Change No.	Page No.	# Change No.
Title	0				
A	0				
i — iii	0				
iv Blank	0				
1-1 — 1-2	0				
2-1 — 2-2	0				
3-1 — 3-4	0				
4-1 — 4-6	0				
5-1 — 5-10	0				
6-1 — 6-8	0				
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A2-1	0				
A2-2 Blank	0				
A2-3 — A2-12	0				

Zero in this column indicates an original page.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

LIST OF ILLUSTRATIONS

SECTION I
INTRODUCTION

1-1. PURPOSE. This manual outlines and defines the requirements, procedures, and responsibilities for weight and balance control of Navy aircraft. Information and explanation of principles and definitions are also presented to provide weight and balance personnel with a general information manual pertinent to their particular function.

1-2. SCOPE. The use of this manual is mandatory for all Navy, Naval Air Reserve, commercial rework facilities, and any other activities that operate, modify and/or maintain Navy aircraft. The general requirements and procedures of this manual are applicable to weight and balance control of all Navy aircraft. Additional requirements and/or procedural instructions for specific TYPE/MODEL/SERIES aircraft weight and balance control are specified in the aircraft's NATOPS Manuals and NA 01-1B-40, Technical Manual, Weight and Balance Data.

1-3. WEIGHT AND BALANCE CONTROL. Operational aircraft weight and balance control shall be accomplished in accordance with the detail requirements and instruction of the specific aircraft NATOPS Manuals, the requirements of this manual, and the forms and procedural instructions of NA 01-1B-40. In case of conflicting requirements, procedures, or instructions, the aircraft's NATOPS Manuals shall take precedence over this manual and NA 01-1B-40, and this manual shall take precedence over NA 01-1B-40, pending mandatory resolution of the conflict through the procedures described in this section.

1-4. WEIGHT AND BALANCE EFFECTS. Flight characteristics of aircraft are directly dependent upon their weight and balance conditions. An aircraft whose weight is greater than its allowable maximum gross weight, or whose center of gravity (c.g.) is located outside its prescribed c.g. limits, may experience one or more of the following unsatisfactory flight characteristics:

a. Longitudinal instability.

b. Lateral instability.

c. Increase in takeoff distance.

d. Increase in control forces.

e. Increase in stall speeds.

f. Decrease in range.

g. Decrease in rate of climb.

h. Decrease in structural safety factors.

These hazardous flight conditions and associated accidents can be prevented by using the principles and following the instructions contained in this manual.

1-5. TERMINOLOGY. Usage of the words "shall," "will," "should," and "may" is in accordance with the following:

a. The words "shall" and "will" are used to indicate the requirements, procedures, and/or responsibilities which are mandatory.

b. The word "should" is used to indicate a non-mandatory but preferred method of accomplishment.

c. The word "may" is used to indicate an acceptable or suggested means of accomplishment.

1-6. RELATED REFERENCES. Weight and balance personnel shall be familiar with the following related technical manuals (supplementary data to this technical manual) and other related documents:

a. NA 01-1B-40: Technical Manual, Weight and Balance Data.

b. Charts A & E: Basic Weight Check List and Loading Data.

c. OPNAVINST 4790.2B: The Naval Aviation Maintenance Program (NAMP); Vol's II & IV.

d. OPNAVINST 3710.7J:

e. MIL-W-25140B

f. MIL-STD-1374

g. NAVAIRINST 13060

1-7. USER COMMAND COMMENTS. Errors, omissions, questions or recommendations relative to this manual, NA 01-1B-40, or the DD 365 series forms shall be reported to:

Commander, Naval Air Systems Command
AIR-5222
Washington, D.C. 20361

NOTE

Changes or corrections to the body of the NA-01-1B-40 Technical Manual, Weight and Balance Data, are made through the normal technical manual change procedure. However if corrections or changes are required for the Charts A and E which are contained within the NA 01-1B-40, contact NAVAIR AIR-5222. NAVAIR is responsible for making corrections and disseminating them in the most appropriate manner.

SECTION II
WEIGHT

2-1. GENERAL. One of the basic elements of aircraft design is weight. The estimated weight of an aircraft is used in determining such design criteria as engine requirements, wing area, landing gear requirements, and payload capacity. So any weight changes, whether in manufacturing, modification, or maintenance, will have distinct effects on aircraft performance and/or payload capability.

2-2. WEIGHT TERMINOLGY. Figure 2-1 illustrates the meaning of, and relationships between, aircraft weight terminology. For related definitions, see APPENDIX 1.

2-3. WEIGHT LIMITS. All aircraft are designed with a number of weight limits. These limits are determined by performance, control, and structural restrictions. Exceeding these limits can result in loss of the aircraft and is expressly forbidden.

2-4. PERFORMANCE EFFECTS. If the aircraft's actual weight exceeds the design weight, reductions in performance and/or payload result. An increase in gross weight increases takeoff speed, stalling speed, and landing ground run. Rate of climb, ceiling, and ranges decrease with increasing gross weight. If the operating weight increases while performance requirements remain the same, then the payload and/or fuel must decrease.

2-5. AIRCRAFT WEIGHT. The weight of an aircraft is determined through a combination of actual weighings, accurate record keeping, and proper use of the aircraft's NA 01-1B-40 Technical Manual, Weight and Balance Data.

2-6. FLOOR LOADING. Floor loading is the weight, in pounds, of a load divided by the area of floor on which it rests. The aircraft's NATOPS Manuals usually specify the floor loading limits and/or weight limits for the various aircraft compartments. Refer to Chart E, NA 01-1B-40, for compartment floor loading limits when applicable.

NOTE

The floor loading limits of an aircraft shall never be exceeded.

WEIGHT TERMINOLOGY

WEIGHT EMPTY

+

Guns, unusable fuel, oil, ballast, survival kits, oxygen, and any other internal or external equipment not disposed of during flight and not listed in the Chart E.

+

Any Basic Weight Check List Record (Chart A) items which are missing from the aircraft.

=

BASIC WEIGHT

+

Crew, crew baggage, steward equipment, emergency equipment, special mission fixed equipment, and all other nonexpendable items (such as fixed pylons and racks) not in basic weight.

=

OPERATING WEIGHT

+

Usable Fuel.

+

Payload items; such as cargo, ammunition, passengers, stores, disposable fuel tanks, and transfer fuel.

=

TAKEOFF GROSS WEIGHT

-

Load items expended in flight; such as fuel, stores, ammunition, cargo and paratroops.

=

LANDING GROSS WEIGHT

Figure 2-1. Weight Terminology

SECTION III
BALANCE

3-1. PURPOSE. This section describes the basic principles of weight, arm, and moment in aircraft balance. The use of these principles is discussed in Section VI. The use of load adjuster indexes is discussed in Section VII, and an example for the completion of a Form F using a load adjuster is given in APPENDIX 2. Only longitudinal balance is discussed in this manual, since few aircraft require vertical and/or lateral balance control. For those aircraft that do, refer to NA 01-1B-40 for that specific model.

3-2. TERMINOLOGY. The terms balance, arm, balance arm, moment, simplified moment, load adjuster index, and center of gravity (c.g.) are fundamental to aircraft balance understanding and control. These and other terms used in this section are defined in APPENDIX 1.

3-3. DISCUSSION. An aircraft is said to be in balance, or balanced, when all weight items in, on, or of the aircraft are distributed so that the longitudinal center of gravity (c.g.) of the aircraft lies within a predetermined c.g. range. This range is defined by the most forward and aft permissible c.g. locations, which are called the forward and aft c.g. limits, respectively. To determine if an aircraft is balanced, the aircraft c.g. must be calculated and compared to the the forward and aft c.g. limits for that particular configuration and gross weight.

3-4. CALCULATING AIRCRAFT C.G.. The c.g. of a group of items, such as a loaded aircraft, can be calculated when the item's weights and arms are known. This can be done by using moments. An example of this process is given in figure 3-1.

a. First, record the aircraft's basic weight and moment from the Chart C. Remember, the Chart C's basic moment is a simplified moment and must be multiplied by the given constant to attain the true moment.

b. Determine the moments of the load items, either by multiplying the individual weights by their arms, or by recording them out of the Chart E.

NOTE

The longitudinal reference datum on some aircraft is not located forward of, but within, the aircraft. Thus, if negative arms are encountered with added (positive) weight, the moments are negative. If negative arms are encountered with deleted (negative) weights, the moment is positive. If positive arms are encountered with added (positive) weights, the moments are positive. If positive arms are encountered with deleted (negative) weights, the moments are negative. The addition or deletion of an item at the reference datum contributes no moment (see figure 3-1).

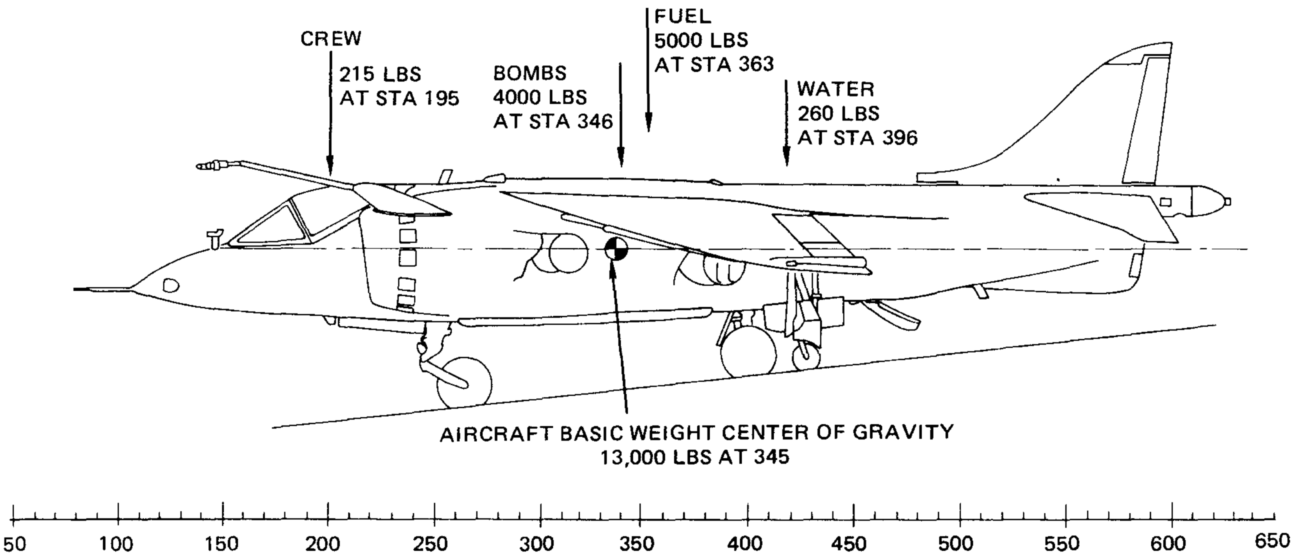

Figure 3-1. Aircraft Center Of Gravity With The Effects Of Useful Load Items

c. Next, sum the weights of the items and the basic weight and sum the moments of the items and the basic moment.

d. By dividing the moment sum by the weight sum, the balance arm, or c.g., of the loaded aircraft is calculated.

3-5. FUSELAGE STATION. Fuselage Station (FS) is often equal at each point to the balance arm scale. However, if the aircraft fuselage is shortened or lengthened, the original fuselage sections usually retain their old FS designations. Such changes most often occur in the design or production phase, before the aircraft becomes operational. This alters the FS-balance arm relationship (see figure 3-2).

NOTE

Balance calculations are not to be worked using FS locations; use only balance arms. The FS location is not always equal to the balance arm.

3-6. PERCENT MAC. The location of an aircraft's c.g. is commonly expressed not by its balance arm, but by percent MAC. Percent MAC identifies a location with respect to the position of the MAC; 0.0 percent at the leading edge of the MAC and 100.0 percent at the trailing edge. For definition, see APPENDIX 1. For our purposes, percent MAC is found by a simple mathematical conversion equation or tables, particular to the aircraft, and listed in the Chart E (see figure 3-3).

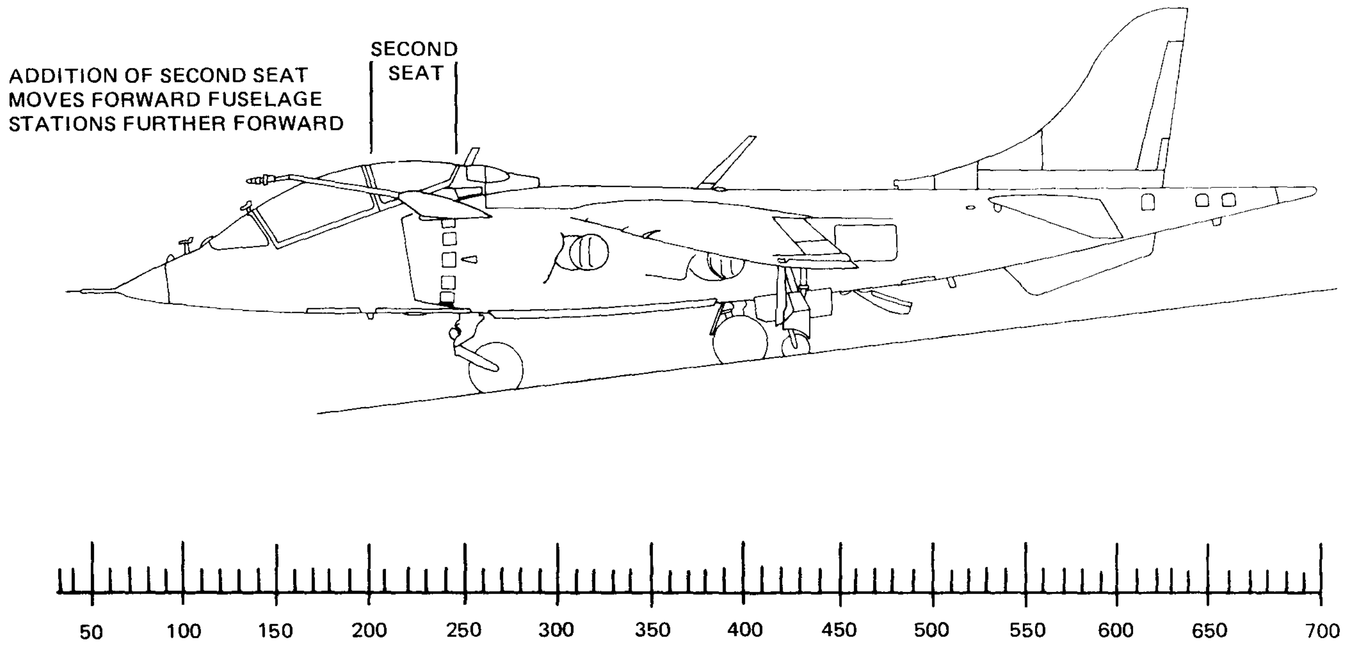

Figure 3-2. Effect On Moment Arms With Fuselage Plug

3-7. LOADING/UNLOADING. The loading/unloading of items can have a considerable effect on aircraft balance, even when the items total less than one tenth of one percent of the aircraft's weight. Balance loading principles and the techniques for determining the balance of various aircraft configurations are discussed in Section VI, Center of Gravity Loading Calculations.

3-8. BALLAST. Sometimes design, manufacturing, or maintenance changes cause the aircraft's c.g. to exceed its limits. This is usually corrected by the addition of permanent ballast which always remains in the aircraft. When ballast is added to counter the temporary removal of an item or to balance a particular configuration, it is called temporary ballast. For a definition of ballast, see APPENDIX 1. An equation for use in determining the amount of temporary ballast is included in Section VI.

NOTE

Addition of ballast on operational aircraft must be done with extreme caution. Installation must be accomplished in accordance with the engineering requirements which must be followed for any structural change. Strength of structure where ballast is installed must not be compromised so as to affect the safety of the aircraft.

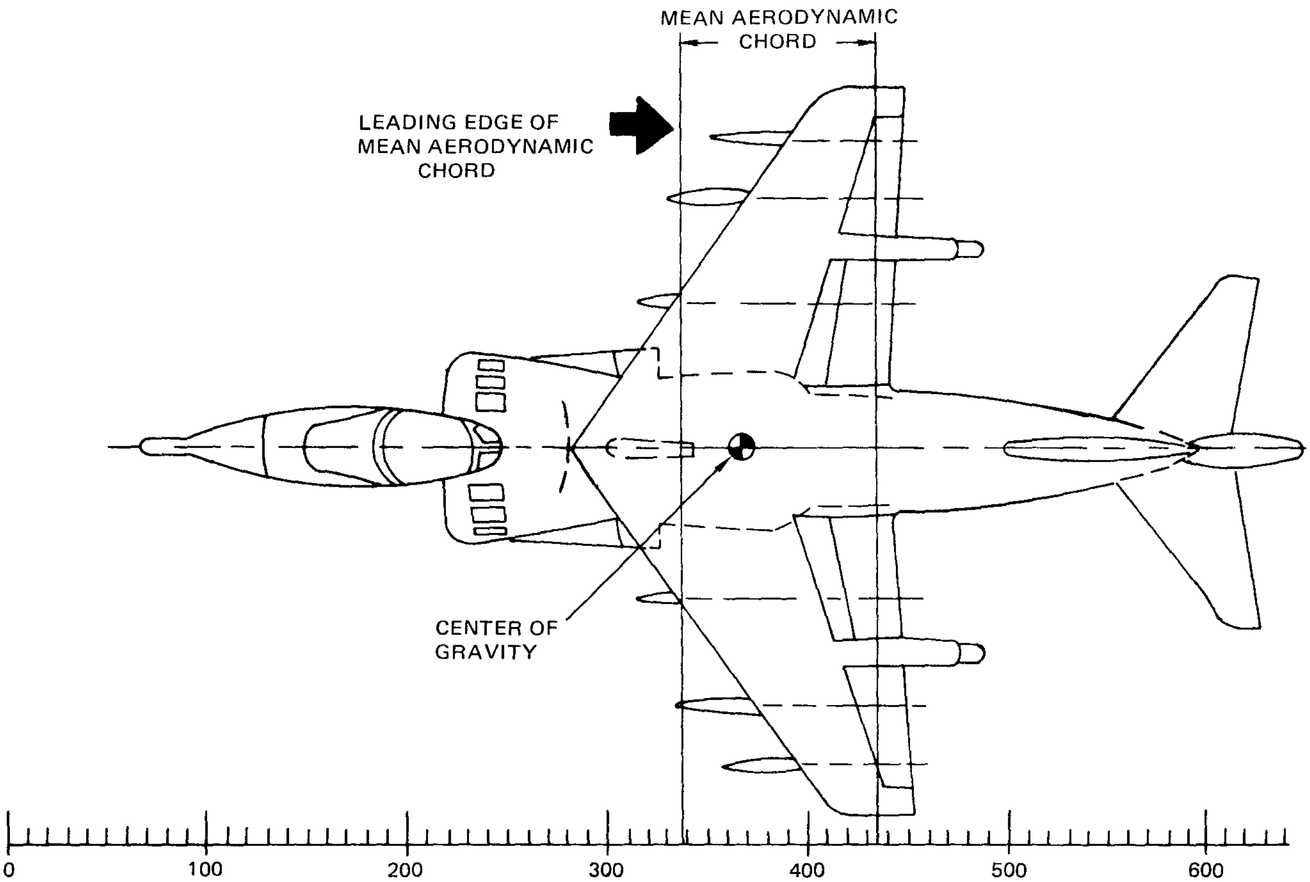

Figure 3-3. Mean Aerodynamic Chord And Its Relationship To Aircraft C.G.

SECTION IV
WEIGHT AND BALANCE SYSTEM

4-1. GENERAL. This section defines the requirements, procedures, and Command responsibilities relative to the Naval aircraft weight and balance control system. The overall objectives of the system are to provide current and correct information regarding aircraft basic weight and moment index and to maintain aircraft gross weight and center of gravity within permissible limits.

4-2. NAVAL AIR SYSTEMS COMMAND (NAVAIRSYSCOM) RESPONSIBILITIES. NAVAIRSYSCOM shall maintain overall responsibility for establishing the requirements, procedures, and forms format of the Naval aircraft weight and balance control system. AIR-5222AV, 222-7545, is the office of primary responsibility for these duties which include:

a. Establishing the technical content and format of this manual, NA 01-1B-40, and the DD 365 series forms.

b. Approving the technical content and format of aircraft Charts A & E.

c. Specifying the weight and balance classifications for Naval aircraft models.

d. Developing specialized weight and balance engineering services.

e. Coordinating and recommending changes to the weight and balance requirements of OPNAVINST 3710.6 and 4790.2.

f. Coordinating and recommending changes to the weight and balance training courses.

g. Coordinating and recommending procedures and/or equipments required for compliance with the various requirements of the weight and balance control system.

NAVAIRSYSCOM shall prepare, procure, and disseminate aircraft weight and balance data that using Commands require to comply with the Naval aircraft weight and balance control system requirements. NAVAIRSYSCOM shall also provide technical assistance for unusual weight and balance problems as requested by using Commands.

4-3. CHIEF NAVAL EDUCATIONAL TRAINING (CNET) RESPONSIBILITIES. CNET shall prepare and provide introductory weight and balance instruction and training required for using Command compliance with the USN aircraft weight and balance control system. CNET shall coordinate course content and special training procedures with NAVAIRSYSCOM.

4-4. USING COMMAND RESPONSIBILITIES. Using Commands shall establish effective operating procedures for weight and balance control of aircraft assigned to their command to ensure that:

a. The weight and balance control system requirements and procedures of this manual, NA 01-1B-40, and related technical documentation are complied with in accordance with the management requirements of OPNAVINST 4790.2 and OPNAVINST 3710.7. When necessary, the using Commands may impose more stringent requirements for weight and balance control through Command supplements to applicable Navy manuals and regulations. The weight and balance control system requirements and procedures shall include, but not necessarily be limited to:

(1) The updating of records to the current weight and balance status for all assigned aircraft.

(2) The development of methods for aircraft loading that are satisfactory for safety of flight.

(3) The proper utilization or modification of weight and balance data.

(4) The proper completion of the Form F as required.

(5) Assisting flight crews in proper weight and balance maintenance.

b. Military and civilian personnel assigned the responsibility for accomplishing the various weight and balance functions are qualified by graduation from one of the NARF weight and balance schools.

c. The using Command may implement procedures to simplify aircraft weight and balance maintenance which do not conflict with this manual, NA 01-1B-40, or other applicable directives.

4-5. AIRCRAFT WEIGHT AND BALANCE CLASSES. For weight and balance control purposes, Navy aircraft are divided into the following classifications:

a. Class 1. Class 1 aircraft are those which require basic weight and moment record documentation but do not require loading control for normal configurations. Normal configurations are defined as configurations previously flown which cannot exceed weight, structural, and/or center of gravity limits.

b. Class 2. Class 2 aircraft are those which require basic weight and moment record documentation and loading control to ensure that loading arrangements employed do not exceed permissible weight, structural, and/or center of gravity limits. Loading control is accomplished in accordance with the instructions and data in the aircraft's Technical Manual, Weight and Balance Data (NA 01-1B-40), this manual, and the NATOPS Manual.

4-6. NAVY AIRCRAFT WEIGHT AND BALANCE CLASSIFICATIONS. Aircraft of similar model designation shall take on the same weight and balance classification as the basic aircraft unless specifically designated otherwise. For aircraft models not listed in table 4-1, assume a Class 2 designation and contact AIR-5222 for further information.

4-7. WEIGHT AND BALANCE HANDBOOKS. An aircraft weight and balance handbook provides for the continuous record of the weight and balance of a particular aircraft.

a. Handbook Location. Class 1 aircraft weight and balance handbook shall be stored in a location as determined by the commands. Class 2 weight and balance handbooks will be stored as determined by the commands, but always in a location readily available to pilot and other personnel responsible for accomplishing the weight and balance functions. Handbooks shall never be located on aircraft except when being transferred.

Table 4-1. Aircraft Weight and Balance Classifications

CLASS	VA VS	VF	H	VO	VP	VR VW	VT	VU
1.	A-3 A-4 A-6 A-7 AV-8 EA-6 S-2 S-3	F-4 F-5 F-8 F-14 F-18	TH-57 AH-1 CH-46 SH-2 SH-3 UH-1 UH-2 UH-46	U-11 OV-10	-	E-2	T-2 T-28 T-34 T-33 T-38 T-39 T-44 TC-4	U-1 U-3 U-6 U-9 UC-12
2.			CH-53 RH-53		P-2 P-3	C-1 C-2 C-9 C-117 C-118 C-121 C-130 C-131		

NOTE: All versions of the models listed shall be in the class designated.

b. Handbooks. A weight and balance handbook shall be maintained for each assigned aircraft by qualified weight and balance personnel. The handbook charts, forms and records shall be maintained in accordance with the requirements and instructions of this manual and NA 01-1B-40. The contents of the primary weight and balance handbook shall be arranged and maintained in the following order:

(1) NA 01-1B-40 with completed title page.

(2) Chart E - LOADING DATA.

(3) DD Form 365 - RECORD OF WEIGHT AND BALANCE PERSONNEL.

(4) DD Form 365A (DD Form 365-1); Chart A - BASIC WEIGHT CHECK LIST.

(5) DD Form 365B (DD Form 365-2); Form B - AIRPLANE WEIGHING RECORD.

(6) DD Form 365C (DD Form 365-3); Chart C - BASIC WEIGHT AND BALANCE RECORD.

(7) Required copies of DD Form 365F (DD Form 365-4); Form F - WEIGHT AND BALANCE CLEARANCE.

c. Handbook Security Classification. Aircraft weight and balance handbooks shall be classified in accordance with the highest security classification of the data contained therein.

d. Handbook Replacement. In the event an aircraft weight and balance handbook becomes lost, damaged, or for any reason needs to be replaced, the individual assigned responsibility for that aircraft's handbook shall assemble a new handbook as follows:

(1) Obtain a new NA 01-1B-40 and complete the title page.

(2) Copy a Chart E from another similar aircraft's NA 01-1B-40 or obtain a copy from NAVAIRSYSCOM (AIR-5286).

(3) Obtain and complete a DD Form 365 per the instructions of NA 01-1B-40.

(4) Obtain sufficient copies of DD Form 365A (DD Form 365-1) and use an applicable aircraft Chart A to prepare a new Chart A per the instructions of NA 01-1B-40 or obtain a copy from NAVAIRSYSCOM (AIR-5222).

(5) Inventory the aircraft in accordance with instructions of NA 01-1B-40.

(6) Weigh the aircraft by a NARF Team or another acceptable source.

(7) Obtain DD Form 365C (DD Form 365-3) and complete the initial entry from DD Form 365B (DD Form 365-2) per the instructions of NA 01-1B-40. Include a note at the top of the "Description of Article or Modification" column identifying the reason for assembling a new handbook.

(8) Obtain and prepare DD Form 365F (DD Form 365-4); Form F - WEIGHT AND BALANCE CLEARANCE form in accordance with the instructions of NA 01-1B-40.

e. Handbook Updates. When new equipment is installed, or when old equipment is removed, modified Charts A and C in accordance with the instructions in NA 01-1B-40. New Forms DD Form 365A (DD Form 365-1) may be added when the originals are filled up.

4-8. WEIGHT AND BALANCE FLIGHT CLEARANCE. Weight and balance flight clearance is accomplished to ensure that aircraft remain within safe weight and balance limits during takeoff, flight, and landing. Such clearance is recorded through the use of DD Form 365F (DD Form 365-4); Form F - WEIGHT AND BALANCE CLEARANCE form, or through an authorized substitute (see 4.10.e). The original copy of the Form F, when properly signed and filed in accordance with established operational procedures as stated in OPNAVINST 3710.7J, serves as the record to certify that weight and balance clearance was properly accomplished.

a. Required Clearance. Class 2 aircraft require weight and balance clearance prior to each flight. Class 1 aircraft do not require weight and balance flight clearance for normal configurations, but do require flight clearance for all configurations not previously flown.

b. Form F Procedures. All DD Form 365F's (DD Form 365-4) shall be completed using the instructions contained in NA 01-1B-40. DD Form 365F's are initiated on a flight by flight basis or can be retained for repetitive type flights, where identical loadings are used.

(1) "ONE TIME USE Form F -" These are DD Form 365F's (DD Form 365-4) prepared for use for a single flight and are destroyed upon mission completion.

(2) "REPETITVE OPERATIONS Form F -" These are DD Form 365F's (DD Form 365-4) prepared for repeated operations with various, but frequently used common loadings. Prepare DD Form 365F (DD Form 365-4) in duplicate for each of the var-

ious loadings. File the original at activity from which the flight originated and insert a copy in the handbook NA 01-1B-40. Preparation of a new DD Form 365F (DD Form 365-4) is not required when the NA 01-1B-40 contains a duplicate DD Form 365F (DD Form 365-4) dated within the last ninety days, for an identical load, and the basic weight and moment agrees with the latest Chart C basic weight and moment.

(3) When preparing the DD Form 365F (DD Form 365-4), using data from Chart E for that model aircraft, ensure the take off, flight and planned landing gross weights and center of gravity (c.g.) locations are within the established limits. Each loading will require a separate DD Form 365F (DD Form 365-4).

(4) Prepare replacement forms whenever a change in the basic weight and moment render the loading incorrect.

(5) Inspect to ensure the aircraft loading is in agreement with the DD Form 365F (DD Form 365-4) being used.

c. Clearance Procedure. When filing DD Form 175, MILITARY FLIGHT PLAN (or authorized substitute), pilots shall either attach the original copy of a "One Time Use" DD Form 365F (DD Form 365-4) or note that a previously filed DD Form 365F (DD Form 365-4) is applicable. Duplicate copies of DD Form 365F (DD Form 365-4) shall be filed in accordance with command operational procedures. One of the following entries shall be made in the appropriate space on DD Form 175:

(1) "ATTACHED" - When a "ONE TIME USE" DD Form 365F (DD Form 365-4) is attached.

(2) "FILED AT ______________, DATE ______________" - When citing a previously filed DD Form 365F (DD Form 365-4).

d. Authorized Substitutions For DD Form 365F (DD Form 365-4). The following substitutes are authorized for use as weight and balance clearance records in lieu of DD Form 365F (DD Form 365-4):

(1) Electronic computer printout sheets when the data recorded is identical to that required on the DD Form 365F (DD Form 365-4).

(2) The designated commercial type loading schedule as for C-9 aircraft.

4-9. AIRCRAFT WEIGHING REQUIREMENTS.

a. Each aircraft shall be weighed upon completion of SDLM.

b. Aircraft shall also be weighed:

(1) When service changes, modifications, or repairs are accomplished and calculated or actual weight and moment data for these changes are not available.

(2) When recorded weight and balance data is suspected of being in error.

(3) When unsatisfactory flight characteristics are reported by the pilot which cannot be traced to flight control system malfunction, improper aircraft loading, or error in weight and balance data and/or computations.

(4) When handbook (NA 01-1B-40) has been lost or damaged.

4-10. WEIGHT AND BALANCE CHARTS AND FORMS. The standard system of weight and balance control requires the use of several different charts and forms. APPENDIX 2 of this manual illustrates samples of these charts and forms. Detail instructions for use of the following referenced charts and forms are contained in NA 01-1B-40.

a. DD Form 365; Record Of Weight And Balance Personnel. This form is used to provide a continuous record of weight and balance personnel responsible for maintaining the aircraft's weight and balance handbook and preparation of DD Form 365F (DD Form 365-4) and their qualification date.

b. DD Form 365A (DD Form 365-1); Chart A - Basic Weight Check List. The basic weight check list is a completed collection of DD Form 365A's (DD Form 365-1) for a particular aircraft, referred to as Chart A. It is a list of operating equipment, by aircraft compartment, which is or can be installed in the aircraft.

c. DD Form 365B (DD Form 365-2); Form B - Aircraft Weighing Record. This form is used to record data obtained from aircraft actual weighings.

d. DD Form 365C (DD Form 365-3); Chart C - Basic Weight and Balance Record. This record is a continuous series of completed DD Form 365C's (DD Form 365-3). It is a continuous and permanent record of basic weight, moment/index, and center of gravity position for a specific aircraft.

e. DD Form 365F (DD Form 365-4); Form F - Weight and Balance Clearance Form. This form records the weight, moment or index, and center of gravity calculations for a specific loading arrangement on a specific aircraft to ensure the aircraft remains within its weight and balance limitations.

f. Chart E - Loading Data. This contains the information necessary to perform aircraft loading control (weight and balance flight clearance computations) and to accomplish actual weighings for a specific aircraft model.

SECTION V
WEIGHING AIRCRAFT

5-1. GENERAL. Aircraft weighings are required as outlined in Section IV. Weighing with calibrated scales is the only sure method of obtaining an accurate basic weight and center of gravity (c.g.) location on an aircraft. When an aircraft is to be weighed it should be as near to its basic weight configuration as possible. It must be inventoried for equipment actually present in the aircraft and must be in a defueled condition.

5-2. WEIGHING EQUIPMENT. A variety of scales and equipment may be used for weighing aircraft. At the present time standardization tends toward an electronic portable platform scale. Some of the weighing systems now being used to weigh Navy aircraft are as follows:

a. Mobile Electronic Weighing System (MEWS). This system shown in figure 5-1 is designed to provide weight data and compute the c.g. of aircraft (as well as wheeled vehicles and cargo loads). The complete system is portable and either includes a trailer for storage and transport or is mounted on a single 88 x 108 inch pallet. Typical installation set-up time by two men is 30 minutes.

b. Heavy Duty Portable Scales - Truck Type. This system is designed to provide weight only. Wheeled vehicles and cargo may also be weighed on these scales. The complete system is very portable and completely self contained (i.e., platform and readout). Platform size is small but may be increased by connecting two scales with factory provided channel. Care must be exercised because of small platforms. Typical installation set up time by two men is 10 minutes.

c. Stationary Pit Type Scales. Most of the large scales are of the stationary beam and lever balance type (see figure 5-2). These scales are commonly flush floor installations, although some are used as surface-type portable scales. The flush floor installation generally is in a permanent location and the aircraft must be taken to them. However, some flush floor scales have the capability to be removed from their installations when necessary and taken to the aircraft. These scales are usually expensive and normally require a special building or hangar.

d. Electronic Load Cells. Load-cells-on-jacks is not a permissable method for weighing Navy/Marine aircraft because of the possibility of side loads adversely influencing the weight and c.g. results and because of the possibility of aircraft falling off the load cell/jack combination.

5-3. CALIBRATION OF WEIGHING EQUIPMENT. NARF Commanders or organizations which operate, maintain, or modify aircraft are responsible for having weighing equipment under their jurisdiction calibrated periodically and certified by a government inspector of weights and measures or by commercial scale officials. The large flush floor permanent (pit type) scales shall be calibrated or certified correct at least once every 12 months. Portable heavy duty and platform electronic weighing kit scales shall be calibrated at least once every six (6) months. All calibrations must be traceable to a National Bureau of Standards (NBS) standard.

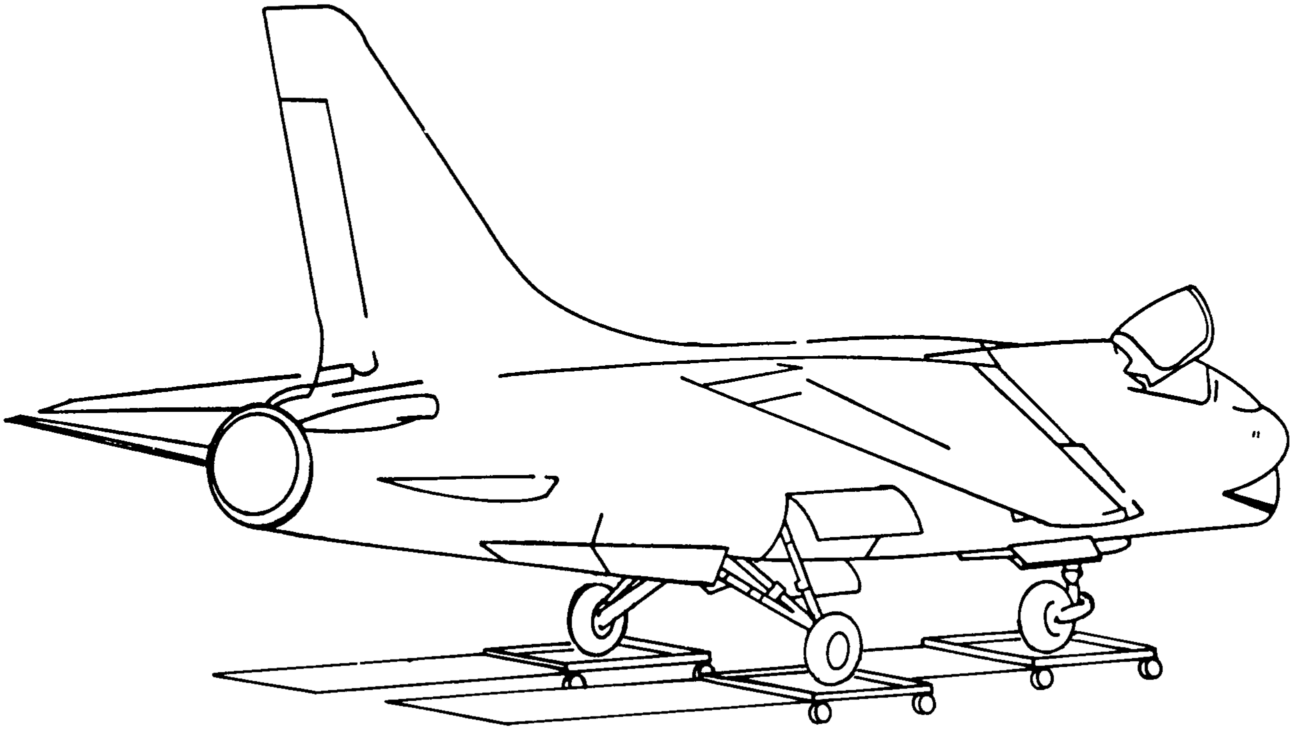

Figure 5-1. Platform Weighing Scales

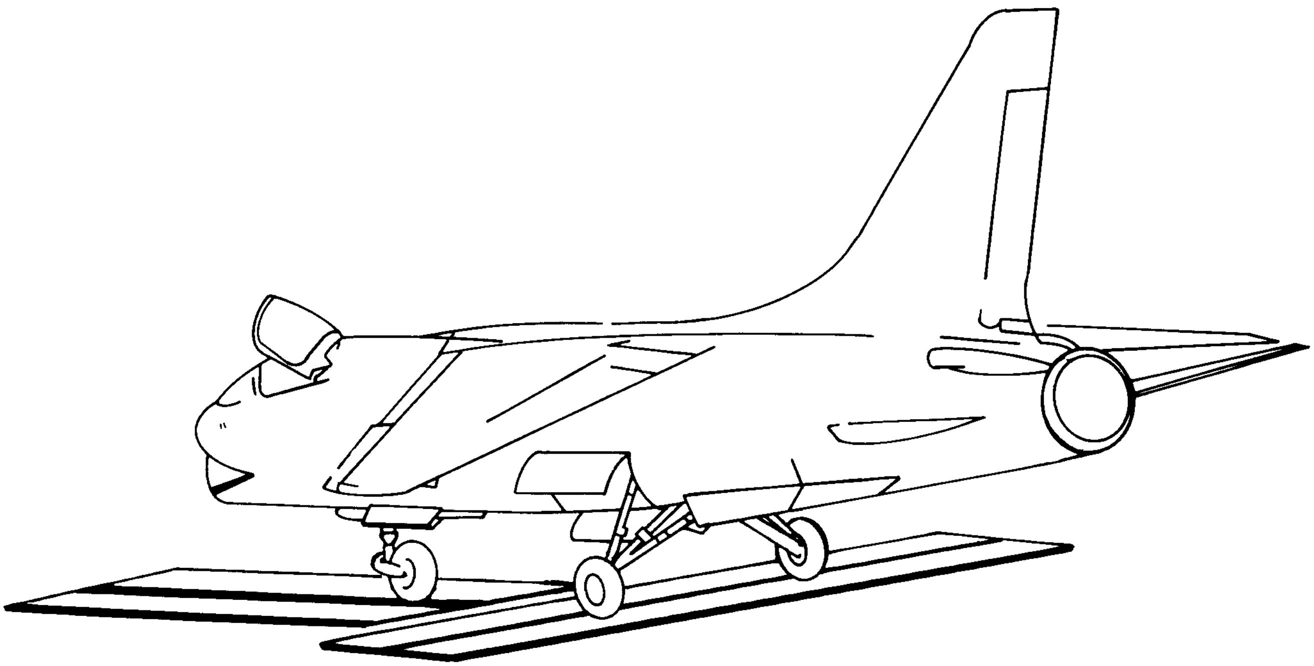

Figure 5-2. Stationary Pit Type Scales

5-4. WEIGHING ACCESSORIES. To measure such data as lengths, angles, and densities, weight and balance personnel require accessories such as levels, plumb bobs, measuring tapes, chalk lines and hydrometers. It may often be necessary to prepare special devices which will facilitate taking measurements and leveling specific types of aircraft. Special equipment, when required, will be called out in the aircraft's Chart E. This equipment should be purchased as, or assembled into a single kit.

a. Spirit Level. At least one spirit level is required for leveling most aircraft. Two levels are generally recommended, however, one 24 inches long for spanning distances between leveling lugs and another 6 inches long to use in places where sufficient space is not available for seating a 24 inch level. The levels should be a machinists' bench type of first-class quality with ground and graduate main vials and plain plumb vials.

b. Leveling Bars. Several leveling bars of varying lengths are needed for spanning the distances between leveling lugs. One set of bars usually comes with the weighing kit normally maintained by each NARF. Some aircraft require special bars which will be called out in the respective Chart E.

c. Plumb Bobs. Plumb bobs are used to project points on the aircraft onto the floor for measuring dimensions in a level plane and for leveling some aircraft. Each plumb bob should have a slot in the head so that excess string which could interfere with the free swing of the plumb bob can be wound around the neck. Plumb bobs are normally included in the weighing kit.

d. Steel Tapes. A steel tape 600 inches in length and graduated in inches and tenths of inches is desired. Since all weighing dimensions must be read to one tenth of an inch and are frequently read to one hundredth of an inch, this type of tape eliminates the nuisance and the possibility of errors associated with converting common fractions to decimals. Tapes as described are usually in the weighing kit.

e. Chalk Line. This is a string, covered with chalk, which is used to mark a straight chalked line on the hangar floor between the vertical projections of the main reaction points of jig locations. The string should be sturdy and hard finished. It usually accompanies the weighing kit.

f. Hydrometers. A hydrometer with a calibration range from 5.5 to 7.0 pounds per US gallon should be used for determining the density of fuel when required. A transparent container for holding fuel samples, a pipette at least 12 inches long, or some other similar device for withdrawing samples from the tank is necessary for use with the hydrometer. Care must be taken not to damage the glassware. When determining the density of a fuel sample, the hydrometer should be carefully placed into the fluid within the transparent container. When reading the density, the hydrometer must not touch the container and the reading should be taken at the lowest fuel point.

NOTE

The hydrometer is used to determine fuel density for full fuel weighings. Since full fuel weighings are permitted only with specific NAVAIR (AIR-5222) approval, a hydrometer will not normally be a part of the weighing kit.

g. Accessory Weighing Kit. A kit containing compartments for each accessory weighing item should be provided for storing and carrying the weighing accessories. This is a necessary precaution against loss.

5-5. WEIGHING PROCEDURES. A defined and orderly aircraft weighing procedure lessens the chance of omitting necessary dimensional or scale readings. The following procedure has been successfully used to accomplish proper aircraft weighing and is recommended. The choice of an alternative procedure depends upon the equipment at hand and on the circumstances under which the aircraft is to be weighed. Always refer to the particular aircraft's Chart E for specific weighing instructions and/or procedures.

NOTE

All resulting weight and balance data are meaningless if proper weighing procedures were not accurately controlled and performed during the weighing.

a. Preparation For Weighing Aircraft. The following describes the recommended procedure to prepare an aircraft for weighing.

(1) Thoroughly clean the aircraft inside and out, removing dirt, grease, and moisture. Allow the aircraft sufficient time to dry prior to weighing.

(2) Assemble the required weighing equipment, including scales, hoisting equipment, jacks, cribbing, leveling bars, level, measuring tape, plumb bobs, and chalk line.

(3) Drain fuel in accordance with the aircraft's Chart E or other applicable instructions. This draining is generally done in the aircraft's normal ground attitude. Aircraft with internal foam in their fuel tanks pose special problems since some fuel is always retained in the foam. In this case, unless specific instructions are in the aircraft's Chart E, draining should be terminated when the fuel flow becomes discontinuous or starts to drip. Only if it is impractical to drain the fuel due to fire hazards or local regulations, may an aircraft be weighed with full fuel tanks. Permission for "full fuel" weighings must be obtained from COMNAVAIRSYSCOM (AIR-5222). Since the density of the fuel varies with temperature and other factors, determine the actual density (weight per gallon) by using a hydrometer. Multiply the density by the gallons of fuel capacity obtained from the Chart E to determine the total fuel weight. Never use the Chart E fuel weight values. For the moment of the fuel, multiply the derived weight by the corresponding arm listed in the Chart E Fuel Table. Never weigh an aircraft with partially filled fluid reservoirs or tanks.

(4) Remove load items such as bombs, ammunition, cargo, crew members, and equipment not having a fixed position in the aircraft. They are not listed as a part of the basic weight on the Chart A and should therefore not be in the aircraft when weighed.

(5) Check all reservoirs and tanks for liquids such as drinking and washing water, hydraulic fluid, anti-icing fluid, cooling fluids, and liquid oxygen. Reservoirs and tanks should be empty or filled to normal capacity prior

to weighing. Oil tanks are to be filled to normal capacity before weighing. Calculations on the weighing record DD Form 365B (DD Form 365-2) will resolve differences between the as weighed condition and the basic weight condition.

(6) All waste tanks must be empty.

(7) Move the aircraft to the area where it will be weighed. Do not set the aircraft brakes for this may induce side loads and thrust loads on the scales which in turn may give erroneous weighing results.

NOTE

The aircraft must be weighed in a closed hangar, or building, with no blowers or ventilating systems impinging air upon the aircraft. The slope of the floor shall not exceed 1/4 inch in one foot (1.2 degrees). Enclosed hangars, or buildings, are the only weighing locations permissable.

(8) Conduct a Chart A inventory of equipment actually installed in the aircraft. This inventory will be done under the supervision of the qualified weight and balance technician responsible for weighing aircraft.

NOTE

A basic weight without the correct associate inventory is of no value. Check the aircraft equipment against the Chart A and correct the chart as necessary to itemize accurately all items of fixed operating equipment that will be included in the basic weight determined by the weighing. The aircraft's Chart A - Basic Weight Check List is absolutely necessary to properly accomplish this inventory. When the Chart A does not accompany the aircraft, it is the responsibility of the weight and balance supervisor or technician to prepare one before weighing. The compilation, completion, and application of the Chart A is described in NA 01-1B-40.

(9) Correct the Chart C based upon the Chart A inventory.

(10) Using such data as the current Chart C basic weight, the Chart A inventory, and the Chart E, estimate an "as weighed" weight and moment. To the current basic weight add the oil (if not part of current basic weight) and "items weighed but not part of the current basic weight" and subtract the "items in the basic weight but not in the aircraft." See example :

EXAMPLE

ITEM	WEIGHT (lbs)	MOMENT/1000 (in-lbs)
Current Basic Weight (from Chart C)	24,890	10,827.0
Oil	+26	+14.9
Weighed but not in Current Basic Weight		
Variable Ballast	+176	+82.2
Not weighed but in Current Basic Weight		
Decoder	-12	-5.1
Liquid Oxygen	-3	-1.2
------------------------------------	----------	----------
Estimated "As Weighed" Weight	25,077	10,917.8
Balance Arm (C.G.)	435.37 in	

b. Actual Weighing. The following describes the recommended procedure to successfully complete an actual aircraft weighing:

When weighing an aircraft with platform scales such as the Mobile Electronic Weighing System (see figure 5-1), or stationary scales (see figure 5-2):

(1) Assure that all scales are within their calibration date. If the scales are portable, set up the scales and level them. Attach the cables from the platform to the readout.

(2) Warm up electronic scales for a minimum of 20 minutes.

(3) Zero the scales.

(4) Level aircraft by servicing or deservicing struts. Most aircraft can be leveled in this manner. See NA 01-1B-40 weighing instructions, Chart E, paragraph 5-5, herein for aircraft where this procedure is not required or desired.

(5) Tow the aircraft onto the scales. Do not apply the aircraft's brakes, because they may bind the scales and this would require rezeroing of the scales.

(6) Recheck the aircraft level.

(7) Read the scales and make dimensional measurements per Chart E instructions and paragraph 5-6 herein.

(8) Make the applicable DD Form 365B (DD Form 365-2) entries and verify the weighing results (see paragraph 5-5a(10) and 5-11). If a large discrepancy is noted, check to see where the error could have occurred. If the source of the error is not found, reweigh aircraft by removing and replacing the aircraft on the scales. Unless specified in the applicable aircraft Chart E, a large discrepancy is 2.0 percent of the basic weight or .5 percent MAC (0.2 inches for rotorcraft).

(9) Remove the aircraft from the scales.

(10) Determine the tare per the appropriate scale instructions. If the scale correction factor is larger than the scale calibrated accuracy, the scale should be repaired. Enter the tare on the Form B.

NOTE

If the scale does not return to zero after ten minutes, reweigh the aircraft. Be sure that the brakes are not used or applied.

(11) Stow the equipment.

5-6. AIRCRAFT LEVELING. All weight and balance computations are based on measurements taken when the aircraft is in a level position. This position is acheived when the longitudinal and lateral axes of the aircraft are in a horizontal plane. Leveling aids have been accurately installed in the aircraft by the manufacturer, and with the proper use of these aids it can be determined when the aircraft is level. Some aircraft use spirit levels to level aircraft, while others use plumb bobs.

NOTE

Some aircraft such as AV-8 and H-46 are weighed in the static, unlevel position. Chart E contains a chart to correct for the degree of unlevelness. In this procedure the angle the longitudinal axis makes to the horizontal plane must be measured by either placing in inclinometer on the leveling bar or using a leveling plate provided in the aircraft by the manufacturer. See Chart E instructions.

a. Spirit Levels. Leveling lugs may be located either on the inside or outside of the aircraft (see figure 5-3). When the lugs are located inside the aircraft it is often necessary for the personnel observing the level to remain in the aircraft while it is being weighed so as to avoid disturbing its equilibrium. In this case the weight and moment of the observer must be deducted from the total weight and moment. To use the leveling lugs, place the leveling bar squarely on the lugs. Then place spirit level on the leveling bar. The aircraft is level when the bubble is centered. The aircraft must be leveled both longitudinally and laterally.

b. Plumb Bob (see figure 5-4). Another device provided for leveling of aircraft is a plumb bob. The primary advantage of this type leveling over the spirit level type is that it is more accurate whenever the drop length is greater than the standard leveling lug span. To level an aircraft by using a plumb bob, suspend the plumb bob from

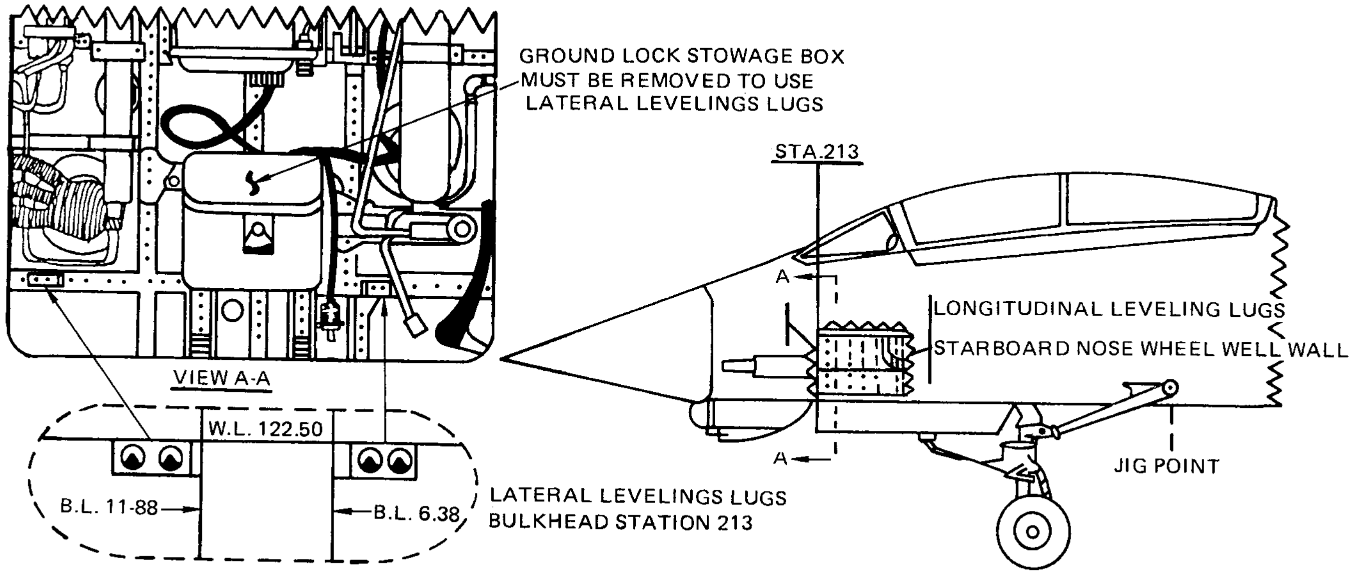

Figure 5-3. Leveling Lug Installation Inside Nose Gear Wheel Well

the upper jig-located bracket. Then service the struts so that the point of the plumb bob is just above the intersection of the cross lines on the lower jig-located index plate. The aircraft will then be level laterally and longitudinally.

5-7. DIMENSIONS REQUIRED FOR C.G. LOCATION. Three horizontal dimensions must be either measured or known to determine the horizontal location of the as weighed aircraft's c.g.. They are:

a. The distance from the reference datum to some known point (preferably a jig point) which is always listed on the aircraft diagram contained in the applicable aircraft Chart E.

b. The distance from the jig point to a chalk line drawn between the two main wheel reaction points.

c. The distance between the main and nose or tail reaction points.

5-8. PROJECTION OF THE JIG AND REACTION POINTS. Horizontal dimensions are best determined by projecting the points to be measured onto the hangar floor. Reaction points may them be accurately located on the hangar floor by measuring from the projected points.

a. Projection Of The Jig Point. Suspend a plumb bob from the center of the jig point so that the plumb bob is approximately 1/8 inch above the floor. Dampen out the swing of the plumb bob and then make a cross mark on the floor directly under the tip of the plumb bob. A piece of masking tape may be placed on the floor upon which the cross mark can be marked. Print on the floor the words "jig point" near the cross to distinguish it from the other reaction points.

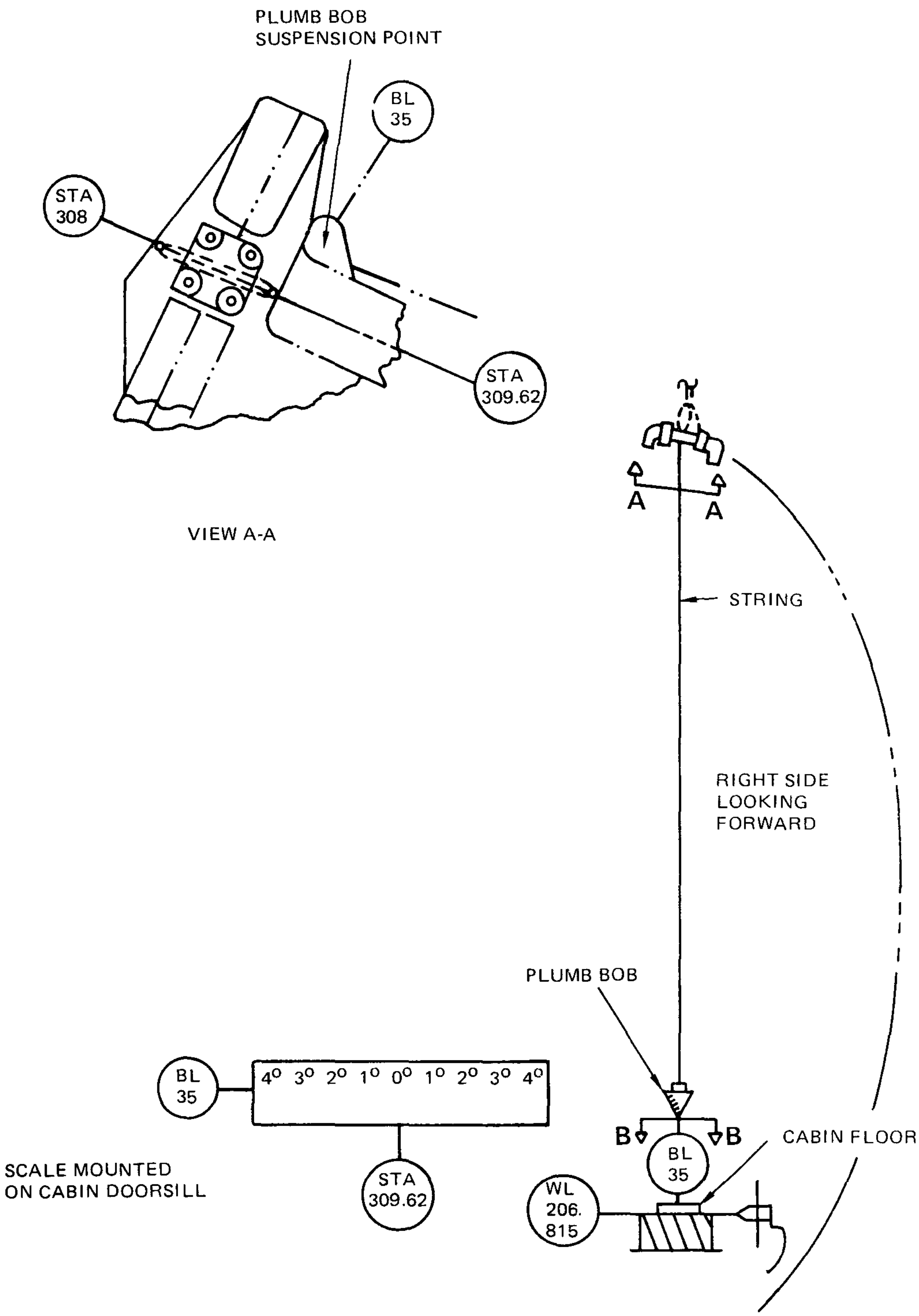

Figure 5-4. Plumb Level In Helicopter Door

b. Projection Of The Center Point Of The Main Reactions. Suspend a plumb bob from the center of each main reaction point to the floor as described above. It is necessary that a free fall be obtained for the plumb bob, so interference must be avoided. It is also necessary that the plump bob be dropped from the exact center of each reaction point (i.e., drop the plumb bob from the center of the axle). After the marks are placed directly under the main reaction points, a chalked line is stretched between these two points and drawn taut. The line is then snapped to the floor, leaving a straight chalk line between the main reaction points.

c. Projection Of Nose Or Tail Reaction. The nose or tail reaction point is projected to the hangar floor in the same manner as described above. It is necessary that the plumb bob be dropped from the exact center of each reaction point (i.e., drop the plumb bob from the center of the axle). The nose or tail wheel must be centered prior to attaching the plumb bob. This projection is then marked on the floor with a small cross.

5-9. TAKING MEASUREMENTS. All measurements should be taken with a steel tape (see paragraph 5-5a(10)). Two of the measurements to be taken are listed as "B" and "D" on the Aircraft Weighing Record. Distance B is the horizontal distance from the projected jig point to the chalk line between the main reaction points. Distance D is the distance from the center line of the main reactions to the nose or tail reaction point. When measuring these distances, the tape must be parallel to the center line of the aircraft. These measurements must be made accurately to a tenth of an inch or better to ensure accurate results in the computations which determine the "as weighed" c.g. location of the aircraft. Measurements taken from the main reaction points must be measured perpendicular to the chalk line joining the two points. These measurements may be determined quickly and accurately by placing the zero end of the tape on the desired point and swinging and the other end of the tape across the main reaction chalk line in a small arc. The shortest distance read off the tape where the tape crosses the chalk line is the perpendicular distance from the point to the line. Care should be taken so that the tape does not get caught on wires or other obstacles and that it is taut and straight.

5-10. RECORDING WEIGHT AND DIMENSIONS. All scale readings and dimensions should be recorded immediately on the Aircraft Weighing Record. Only the distance B and D need actually be measured. Distance I (measured from the reference datum to the jig point) is obtained from the aircraft's Chart E Loading Data.

5-11. VERIFICATION OF WEIGHING RESULTS. If data for comparison are available, an attempt must be made to verify the data obtained from each weighing. Verification may be made by comparing the estimated "as weighed" weight and c.g. (see paragraph 5-5a(10)) to the actual "as weighed" weight and c.g.. If no comparison is available, the aircraft will be weighed three times and the average weight and moment will be used on the Form B with an appropriate note made to this effect in the remarks block. If there have been no major modifications, or additions, the last recorded weight on the Chart C is also a valuable check to verify that the new weighing is reasonable.

SECTION VI
CENTER OF GRAVITY LOADING CALCULATIONS

6-1. PURPOSE. The purpose of this section is to describe the principles and calculations involved in (1) calculating the most forward and aft c.g. conditions for a particular aircraft mission (entered on the Form F for some aircraft) and (2) determining appropriate methods of correction for a mission whose c.g. is found to be outside the allowable limits. This section deals primarily with Chart E weight, arm, and moment calculations. When load adjusters are used, also refer to Section VII.

6-2. LATERAL AND VERTICAL C.G.'s. Lateral and vertical c.g.'s, not controlled on most aircraft, are critical with some and restricted to limits of operation just as the longitudinal c.g.. Rotorcraft balance control often involves tracking both the longitudinal and lateral c.g.'s. Such aircraft are exceptions, however; and even though the principles in the next paragraph basically apply to lateral and vertical balance as well as longitudinal, they and the calculations which follow are intended for use in longitudinal c.g. derivations only. The extra weight and balance maintenance and control necessary for lateral and/or vertical c.g. calculations are called out in the applicable aircraft Chart E.

6-3. LOADING PRINCIPLES. The following principles are derived from the more general balance principles described in Section III. They show both the effects of loading on an aircraft c.g. and methods of correcting unfavorable loading conditions:

a. The distance of an item from the aircraft's c.g., not the distance from the reference datum, determines the effect of the item's weight on the aircraft's c.g.

b. With a given item weight, the aircraft c.g. shift caused by moving the item is directly related to the distance the item is moved.

c. Any weight added forward of the aircraft's c.g. will move the c.g. forward. Conversely, any weight added aft of the c.g. will move the c.g. aft.

d. Any weight removed forward of the aircraft's c.g. will move the c.g. aft. Conversely, any weight removed aft of the c.g. will move the c.g. forward.

e. Any weight moved forward will move the aircraft's c.g. forward and any weight moved aft will move the c.g. aft.

f. A small weight moved a long distance can have as much effect on the aircraft's c.g. as a large weight moved a short distance.

6-4. CHART E LOADING DATA. The Chart E provides all the weight, arm, and moment data necessary to perform c.g. loading calculations. It is predominantly in tabular form, listing the standard weights, arms, and moments of load items in such quantities and locations as are normally used.

NOTE

The weights listed in the Chart E are standard weights. Actual weights should be used whenever possible, especially when dealing with variable weights such as the fuel (density varying with temperature) and the crew (see paragraph 6-6e).

6-5. MOST FORWARD AND MOST AFT C.G. CALCULATIONS. These calculations are designed to determine the most forward and most aft c.g. locations that could normally occur during the mission under consideration. Each computed c.g. should be carried to at least one decimal place and checked against the allowable limits. As the gross weight changes due to fuel use, gun fire, and the release of expendable stores, the allowable c.g. limits may change. If the c.g. exceeds the limits, note it in the calculations but do not begin correction until all the c.g. calculations are completed. Then make the necessary corrections and run through the c.g. calculations again to check the corrected condition. The following calculations deal specifically with Chart E data. The principles described also apply to calculations using a load adjuster; however, clearer calculating procedures for most forward and most aft c.g. calculations using load adjusters are included in Section VII.

a. Takeoff Gross Weight Condition. Prior to any mission c.g. calculations, a takeoff condition must be determined. This is done by adding the various loading data weights and moments to the current CHART C basic weight and moment and computing the takeoff gross weight c.g..

b. Landing Gear Extensions. Unless specifically stated in the Chart E, the takeoff condition is determined with the landing gear down. The lowering or extension of the landing gear causes an aircraft c.g. shift due to a moment change listed in the Chart E. Sum this moment with the takeoff gross weight moment to get a gear-up condition moment, and compute the c.g.. If the c.g. moved aft, the gear-up condition is the aft c.g. condition, while the gear-down is the forward c.g. condition. If it moved forward, then the reverse is true. If there was no apparent c.g. shift, then the gear-up condition is both the forward and aft c.g. conditions.

c. Fuel Burn. Delete from the forward and aft c.g. conditions the weight and moment for the usable fuel. The new weights and moments represent the forward and aft c.g. zero fuel conditions. Now add to these conditions the partial fuel quantities (taken from the Chart E fuel tables) which cause the most forward and aft c.g. shifts. These quantities may not be explicitly called out, and if not, must be found by trial and error. However, these quantities will remain approximately the same for all missions. These calculations result in the forward and aft c.g. fuel burn conditions. Compute the c.g.'s.

NOTE

The fuel quantity with the most forward or most aft c.g. is not necessarily the quantity which will cause the most extreme aircraft c.g. condition. The aircraft c.g. movement is dependent on the weight of the fuel as well as its c.g. location.

NOTE

When alternate fuel tables that reflect the effects of different aircraft attitudes (angles of attack) on the fuel c.g. are listed in the CHART E, these tables must be evaluated along with the standard level-flight fuel tables to determine the forward and aft c.g. fuel burn conditions.

d. Expended Ammo. The c.g. movement caused by gun fire must be considered. Subtract the weight and moment of the ammo carried from the two conditions derived in the last paragraph and add the weight and moment of the ammo (and shells) retained. compute the new conditions' c.g.'s and determine the direction of the c.g. shift. If the gun fire causes an aft c.g. shift when applied to the aft c.g. condition, the gun-fired condition is the new aft c.g. condition. If the gun fire causes a forward c.g. shift when applied to the forward c.g. condition, the gun-fired condition is the new forward c.g. condition. If it causes a forward c.g. shift to the aft c.g. condition or an aft c.g. shift to the forward c.g. condition, the forward and aft c.g. conditions remain as before. If there is no apparent c.g. shift when applied to the forward (or aft) c.g. condition, then the gun-fire is not required for consideration of forward and aft c.g. calculations.

e. Expending Stores. The calculations to determine the c.g. effect of the release of stores involves a number of computations covering each step of prescribed release sequence. If no sequence is prescribed in the aircraft's NATOPS, the sequences which cause the most forward and aft c.g. movement must be determined and their effects calculated.

f. Personnel Movement. In most cargo, transport, and similar aircraft, personnel (crew/troops/passengers) have the freedom to move about inside the aircraft at times during the flight. This movement can have considerable effect on the aircraft's c.g. and should be evaluated. Included in the Chart E are tables which list moment changes which result from the movement of standard weight personnel from one aircraft compartment to another. Remember these moments are positive, or added, when the personnel movement is aft, while they are negative, or subtracted, when the movement is forward.

g. Corrections. Corrections must be made if the calculated forward and/or aft c.g. falls outside the allowable c.g. limits. Some aircraft are equipped to carry variable ballast which can be used to bring the c.g. within limits. In cargo, tanker, and transport aircraft, the c.g. can be shifted through the relocation of cargo, fuel and personnel. The use of alternate fuel and expendable stores sequences can also be used to negate some of the adverse effects of fuel burn and store release. However, whenever corrections are made the mission calculations must be modified and checked so that c.g. limits are not exceeded in other parts of the mission profile.

h. Shift Equation. When the c.g. of a loaded aircraft does not lie within the prescribed limits, and certain load items can be moved about, the c.g. may possibly be corrected by shifting weight from one compartment or position to another. The following equation can be used to determine how much weight to shift how far:

$$W \times D = TW \times C.G.ch$$

W is the shifted weight, in pounds. D is the distance in inches the weight W is shifted. TW, in pounds, is the total aircraft weight. C.G.ch is the number of inches that the aircraft's c.g.

changes due to the shifted weight. This equation can be rearranged to simplify its application into the following equations.

(1) To find how much weight needs to be shifted a known distance D to attain the desired c.g. change C.G.ch:

$$W = \frac{C.G.ch \times TW}{D}$$

(2) To find the distance a known weight W must be shifted to attain the desired c.g. change C.G.ch:

$$D = \frac{C.G.ch \times TW}{W}$$

(3) To find the center of gravity change caused by shifting a known weight a known distance:

$$C.G.ch = \frac{W \times D}{TW}$$

i. Ballast Equation. If weight cannot be shifted to correct a c.g. outside its limits, the load must either be changed or, if applicable to the aircraft, ballast may be added.

NOTE

It is the responsibility of the weight and balance technician to determine the proper amounts of ballast required to maintain the aircraft within the prescribed c.g. limits throughout its flight. The addition of ballast must not impair the structural integrity of the aircraft and therefore any new ballast location must be approved by AIR-5286 before it can be installed. Whenever ballast is required to balance an aircraft after the removal of equipment, ballast may be placed in the vacant equipment mounts up to the weight of the removed equipment. (i.e. Do not overload equipment mounts).

If ballast must be used to move the aircraft c.g. within its limits, the following formual may be used to determine how much ballast must be added to what location.

$$GW\ (C.G.gw - X) = Wb\ (X - C.G.b)$$

GW is the gross weight in pounds of the aircraft before ballasting. C.G.gw is the c.g. in inches of the unballasted aircraft. X is the desired aircraft c.g. in inches. Wb is the weight in pounds of the added ballast. C.G.b is the ballast c.g. in inches. This equation can be rearranged to simplify its application into the following equations.

(1) To find the necessary weight of ballast to be added at a specific location C.G.b:

$$Wb = GW\ \frac{(C.G.gw - X)}{X - C.G.b}$$

(2) To find the location where a given ballast Wb must be placed to move the aircraft c.g. to a desired location:

$$C.G.b = X + \frac{GW\ (X - C.G.gw)}{Wb}$$

6-6. SAMPLE. This sample deals with an FX-1 air superiority configured aircraft. It is armed with four AIM-9J missiles and full ammo, and also carries chaff and flares. The basic weight from the Chart C is 15023 pounds with a moment of 49,208 inch-pounds/100. The forward c.g. limit is 19.6 percent MAC up to 21,000 pounds, and then increases linearly to 31.2 percent MAC at 33,000 pounds for in-flight and 32.5 percent MAC at 33,000 pounds for take-off and landing. The aft c.g. limit is constant at 39.5 percent MAC (see figure 6-1). The MAC and leading edge of the MAC (LEMAC) are 135.84 and 273.11 inches, respectively. Percent MAC is defined as:

$$\text{Percent MAC} = \frac{(\text{Balance Arm} - \text{LEMAC} \times 100}{\text{MAC}}$$

a. The takeoff condition is derived as follows:

	Weight	Mom/100
BASIC WEIGHT	15,023	49208
PLUS:		
Oil	24	90
Crew	215	296
Ammo (retained)	130	331
Ammo (expendable)	157	400
Full Fuel	7294	23166
Missile adapter @ BL 157	51	192
Launcher @ BL 157	139	493
AIM-9 tip	338	1227
AIM-9 BL 157	338	1194
Chaff/Flares	24	110
Take Off CONDITION	23733	76707
C.G.	323.21 inches	

$$\% \text{ MAC} = \frac{(323.21 - 273.11)}{135.84} \times 100 = 36.88$$

(BL 157 is the missile station 157 inches from the center line of the aircraft = Butt Line 157).

b. The landing condition is defined as minus all expendable stores and with 1261 pounds of fuel remaining:

	Weight	Mom/100
Take Off CONDITION	23733	76707
MINUS:		
AIM-9 @ BL 157	-338	-1194
AIM-9 @ tip	-338	-1227
Ammo (expendable)	-157	-400
Full Fuel	-7294	-23166
Chaff/Flares	-24	-110
PLUS:		
1261 lbs Fuel	1261	4033
LANDING CONDITION	16843	54643
C.G.		324.43 inches

$$\% \text{ MAC} = \frac{(324.43 - 273.11)}{135.84} \times 100 = 37.78$$

c. The takeoff and landing c.g.'s are thus within the allowable limits.

d. The next step is to apply the calculations described in paragraph 6-5 to the mission.

(1) The landing gear retraction is defined in the Chart E as causing a minus 15,700 inch-pound moment change. Thus, the aft c.g. condition remains at the takeoff condition, while the forward c.g. condition to this point becomes:

	Weight	Mom/100
Take Off CONDITION	23,733	76707
Landing Gear Retract	0	-157
FORWARD C.G. CONDITION	23,733	76550

C.G. 322.55 inches

$$\% \text{ MAC} = \frac{(322.55 - 273.11)}{135.84} \times 100 = 36.39$$

(2) The fuel quantity which will produce the most aft c.g. shift is determined to be 1975 pounds and 6494 inch-pounds/100.

	Weight	Mom/100
AFT C.G. CONDITION	23,733	76707
MINUS:		
Full Fuel	-7,294	-23166
PLUS:		
1975 lbs Fuel	+1,975	+6494
NEW AFT C.G. CONDITION	18,414	60035

C.G. 326.03 inches

$$\% \text{ MAC} = \frac{(326.03 - 273.11)}{135.84} \times 100 = 38.96$$

The most forward c.g. shift is caused by 5829 pounds and 18143 inch-pounds/100 of fuel. However, the c.g. of this fuel quantity is at 311.25 inches (28.08 percent MAC) which is within the allowable forward c.g. limit at 23733 pounds. If the aircraft c.g. would exceed the forward limit without fuel, the addition of this quantity of fuel could cause the aircraft c.g. to shift rearward to within the forward limit. Therefore, a zero fuel gross weight will be used as the forward c.g. location. If the final forward c.g. condition's c.g. is aft of 311.25 inches, the 5829 pounds of fuel will be included.

	Weight	Mom/100
FORWARD C.G. CONDITION	23,733	76550
MINUS:		
Full Fuel	-7,294	-23166
NEW FORWARD C.G. CONDITION	16,439	53384

C.G. 324.74 inches

$$\% \text{ MAC} = \frac{(324.74 - 273.11)}{135.84} \times 100 = 38.01$$

(3) The expendable ammo is located forward of the forward c.g. limits, so the forward c.g. condition remains with full ammo as in the last paragraph. The new c.g. condition is derived to reflect gun fire (the FX-1 retains ammo cases):

	Weight	Mom/100
AFT C.G. CONDITION	18,414	60035
MINUS:		
Ammo (expendable)	-157	-400
NEW AFT C.G. CONDITION	18,257	59635

C.G. 326.64 inches

$$\% \text{ MAC} = \frac{326.64 - 273.11)}{135.84} \times 100 = 39.41$$

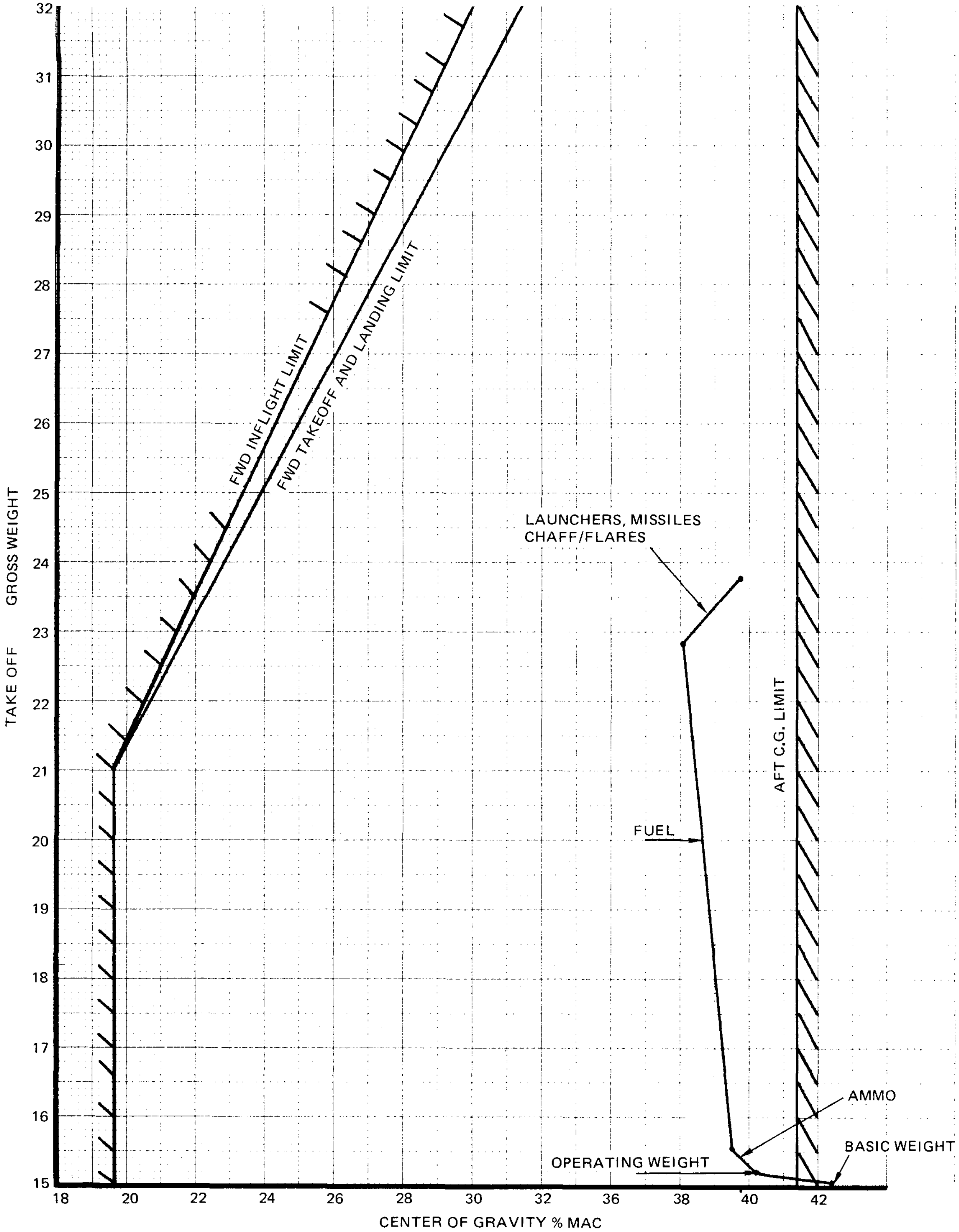

Figure 6-1. Weight vs. Center Of Gravity And C.G. Limits

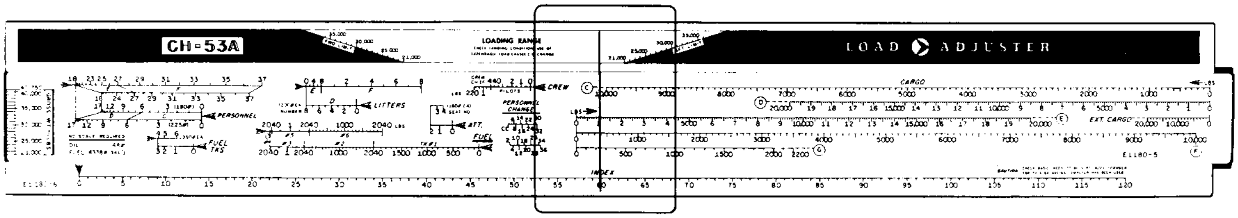

Figure 7-1. Slide-Rule Balance Computer

located on the left end of one side of the slide and is used with the gross weight vs c.g. grid in the recess of the base (see paragraph 7-3).

(2) Circular Type. There are two slides to the circular type balance computer which are attached to the front and back of the base by a rivet. Basic weight vs simplified moment scales are usually located on the same slide as compartment/bomb bay scales. On the other slide are the remaining Chart E loading scales and also a gross weight vs c.g. grid (or equivalent index number and gross weight to c.g. conversion system). On the front and back edges of the circular type base is the index number scale. Also on the base are the aircraft model and the index formula.

(3) Indicator Components.

(a) Base. The base is the part of the Balance Computers that the slide and indicator move over during computation and where the index number scale is located.

(b) Slide. The slide is the part of the balance computer on which the Chart E load item scales are located, as well as the basic weight vs simplified moment scales. The purposes and use of these scales are described in paragraph 7-5.

(c) Indicator. The indicator is the piece of clear plastic which moves over the slide and the base. Inside the plastic and perpendicular to the loading and index number scales is the indicator hairline, used to line up the settings and determine the readings for all balance computer computations.

(d) Carrying Case. The load adjuster is furnished with a leather or neolite case and a metal wall clip for stowage. On the case is a transparent pocket for an identification card and a strap which fits over the tongue of the clip.

(4) Cleaning The Balance Computer. Wash the indicator with a soft, grit-free cloth, chamois, or sponge, using soap and water, kerosene, or naphtha. Do not wipe with a dry cloth or wash with such cleaners as acetone, benzene, lacquer thinner, or kitchen cleaners as they would damage the surface. Automobile or furniture wax covers minor scratches and helps prevent further abrasion. To clean the faces of the slide and base, use caustic-free soap with cold water and wipe dry with a soft cloth or tissue paper.

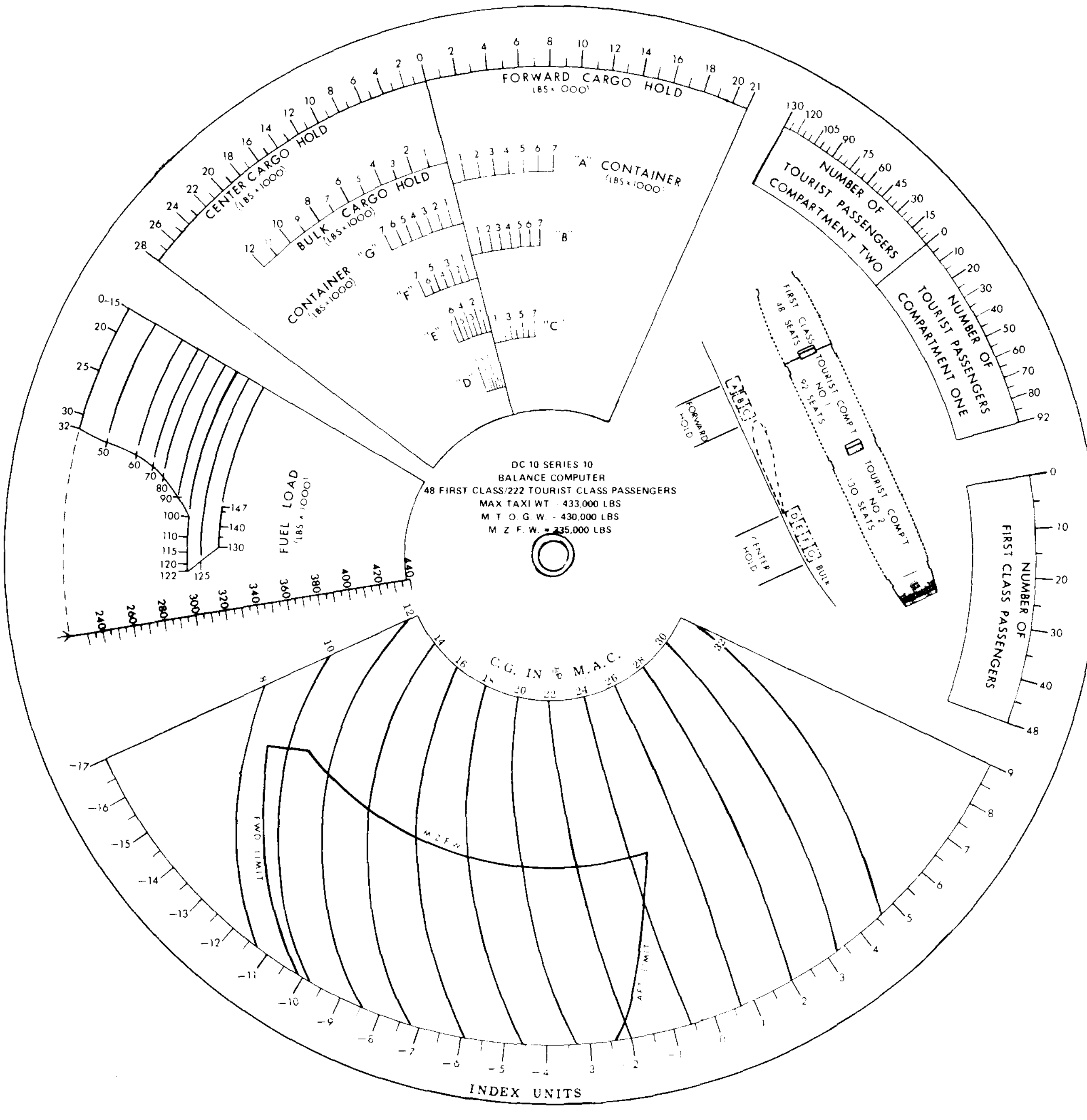

Figure 7-2. Circular Balance Computer

b. Electronic Calculators.

(1) Several aircraft now use hand held electronic calculators. Some models, like the HP-67 used on some P-3 aircraft, have magnetic cards programmed by the user commands for weight and balance. These models may be used for other functions such as navigation, tactical problems, etc.

(2) Other aircraft such as the CH-53E use a model HP-41C calculator which has a pre-programmed memory chip peculiar to one model aircraft which performs a weight and balance function as well as the flight performance calculations normally contained in NATOPS.

(3) Consult the instruction manual for each calculator and use in conjunction with the NA 01-1B-40 Technical Manual, Weight and Balance Data for that specific aircraft.

7-3. LOADING RANGES. The gross weight vs c.g. grids (or their equivalents) are used to determine (1) the c.g. for a particular takeoff or landing condition and (2) if the aircraft will exhibit safe flight or landing characteristics. The latter is done through color-coded loading ranges.

a. Safe Loading Range (White). A loading computation ending with the indicator hairline intersecting the appropriate gross weight in the white area of the grid indicates a safe loading arrangement. Since the edges of this white area define the limiting c.g. conditions for safe flight and landing characteristics, the most preferable gross weight conditions are those represented in the middle of the white area.

b. Caution Loading Range (Yellow). A computation ending in a yellow area indicates loading condition which requires restricted aricraft operations. Such restrictions are called out in the aircraft NATOPS flight manual.

c. Danger Loading Ranges (RED). A computation ending in the red area indicates critical operation conditions. The loading must be redistributed if the hairline intersects the gross weight in this red region. This is mandatory.

7-4. LOAD ADJUSTER INDEX. The load adjuster index is a number which reflects the total aircraft condition and should not be confused with the simplified moment (for clarification; see Section III and APPENDIX A1).

a. Index Formula. The index formula is the master formula for the index number scale and is in the form:

Index Number =

$$C - \frac{[\text{Basic Weight} \times (A - \text{Basic Arm})]}{B}$$

It is printed on the base of both the slide-rule type and circular type load adjusters and in the accompanying instructions. It can be used to directly compute corresponding indexes for conditions where the aircraft weight and moment are known. A, B, and C are constants determined for a specific aircraft and defined as follows:

(1) A is the distance, usually measured in inches, from the usual longitudinal reference datum to a new longitudinal datum used specifically with the load adjuster. This new reference datum is usually located at the aft c.g. limit of the aircraft.

(2) B is a reduction factor which makes the index number easier to handle. Just as a true moment is divided by a factor to get a simplified moment, the balance computer moment (calculated with the distance from the load adjuster reference datum as the arm) is divided by B to get a "raw" index number.

(3) C is added to the "raw" index number to keep it positive. The raw index number (Basic Weight x (A - Basic Arm)/B) can be positive or negative, depending upon whether the c.g. is to the left or right of the balance computer reference datum.

b. Basic Index. The basic index is the reading from the balance computer's index scale which corresponds to the current aircraft basic weight and basic moment. To find this index, either the basic weight vs basic simplified moment scales or the index formula can be used. The operations involved in finding the basic index through the balance computer scales are as follows:

(1) Move the indicator hairline over the arrow at zero on the index number scale.

(2) Move the slide until the basic weight is under the hairline.

(3) Now move the indicator until the hairline is over the basic simplified moment. If it is not on the same scale as the basic weight, move the indicator to the highest simplified moment on the scale. Notice that the next basic weight vs simplified moment scale (directly below) starts with the same simplified moment. So move the slide until the hairline is directly above this simplified moment on the lower scale. Repeat as often as necessary until the hairline is over the basic moment.

(4) The number on the index number scale under the hairline is the basic index.

c. Running Indexes. The running index are the readings taken off the index scale and recorded on the Form F as the Form F is completed (see paragraph 4-8). They relate to the moments of the basic aircraft loaded with all items listed up to and including those specified at that particular loading stage. They are not the individual load item contributions as with simplified moments.

d. Gross Index. The gross index is the running index corresponding to the takeoff or landing condition for a particular aircraft mission. It can be found by using the basic index and the balance computer Chart E scales, the basic weight vs simplified moment scales (see paragraph 7-4b), or the index formula. An example of the latter is when the takeoff gross weight and arm are known, and the effects of expending particular Chart E items are desired.

7-5. CHART E SCALES (LOADING SCALES). On the slide, along with the basic weight vs simplified moment scales, are the Chart E or loading scales. Through these scales the c.g. effects of various combinations of loads can be determined. Each scale has an arrow indicating both the zero mark and the direction in which the indicator is moved for the addition of the load item.

a. Oil Loading Scale. The oil loading is usually presented in a single scale, since oil tanks are often close to one another and equal in capacity. In some aircraft, the oil load index contribution is negligible and the scale is omitted and replaced by an explanatory note. Oil is in basic weight on some aircraft and in those cases will have no oil loading scale on the balance computer.

b. Crew Loading Scales. The crew loading scales are garduated in pounds, crew position, or both. They are usually one continuous scale or multiple scales (corresponding to the crew positions) with the standard weight for each located over the zero mark for the next. In both cases, a full crew can be computed with only one indicator movement.

c. Personnel Loading Scales. This category refers to all non-flight crew personnel. It includes such personnel as console operators, ground troops, paratroops, litters and litter attendants. Usually each is a separate scale graduated in pounds, personnel position, or both. Each individual scale may be divided into smaller scales representing row or compartment position. These smaller scales are generally attached so that the normal row or compartment load setting is directly over the zero mark for the next row or compartment. Thus, the effect of the normal number and location of particular personnel can be determined in one indicator movement. This cannot be done, however, if there are vacancies or overloads, or if the normal number of personnel are not seated in their normal locations. If there is any uncertainty about the normal number or location of personnel, the effects should be determined per individual row or compartment. On some balance computers, the personnel loading scales are combined with the compartment loading scales (see paragraph 7-5d), and may be graduated in both the number of personnel and pounds of cargo per compartment, or only in pounds.

d. Compartment Loading Scales. The compartment loading scales are based on the average arms of cargo loaded into compartments. Often these arms are measured to the geometric center of the compartment. Usually the effects on the running index of items such as baggage and special equipment are determined through compartment scales. The scales are graduated in pounds, extend to the left and the right of a common vertical zero mark, and labeled corresponding to the aircraft diagram on the back of the base.

e. Ammunition Loading Scales. The ammunition is usually represented in a single loading scale (per caliber) since it is normally fed from a common graduated in pounds, rounds, or both. Caution should be taken in determining the effects of expending ammunition using a balance computer if cases can be retained or expended for different missions.

f. Bomb Loading Scales. The bomb loading scales reflect the effects on the running index of such items as bombs, depth charges, torpedoes, and mines. They are generally graduated in pounds.

g. Fuel Loading Scales. The fuel loading scales may be graduated in pounds, gallons, or both. Most are in pounds, with different full fuel loads marked for different fuel densities. The order of the individual fuel tank scales usually indicates the sequence in which the tanks are filled. When tanks are not represented on one continuous scale, the filling sequence moves down the slide face. Most arrangements for noncontinuous fuel scales either extend from a common vertical zero mark or are connected with the maximum fuel mark of one scale directly over the zero mark for the next. With alternate fuel tank configurations, the configuration used when the fuel tank was calibrated is noted near the fuel tank scale. If the fuel in a tank has a near constant c.g. located on or very near the balance computer reference datum, the index contribution will be negligible and will be noted as such.

h. Miscellaneous Loading Scales. This is a general category referring to load items peculiar to a particular aircraft design, mission, or configuration, such as injection water, portable water, JATO, chaff and flares.

i. Crew/Personnel Movement Scales. The movement of crew and mission personnel changes the arms for their respective weights and also changes the aircraft moment and c.g.. That is why there are usually crew/personnel movement scales on the load adjuster. These scales are derived for a standard personnel weight selected to represent one member of the crew or mission personnel. They are graduated in compartments so that the effect on the running index of personnel moving from one compartment to another can be easily computed. Some aircraft require some crew to move either forward or aft for takeoff or landing to improve the c.g. condition of the aircraft.

7-6. USING THE LOADING SCALES. The loading scales can be used to compute the effect of the addition or expenditure of a specific load item on any running index.

a. Addition. The procedure to compute the running index for the addition of a specific load item is as follows:

(1) Move the slide until the zero mark of the specific loading scale is under the indicator hairline.

(2) Move the indicator until the hairline is over the weight or quantity of the addition to be computed.

(3) The reading now under the hairline is the running index which corresponds to the original aircraft condition plus the specific load item.

b. Expenditure. The procedure used to compute the running index for the expenditure of a specific load item is as follows:

(1) Move the slide until the setting corresponding to the total weight or quantity of the specific load item contained in the aircraft condition is under the hairline.

(2) Move the indicator until the hairline is over the setting which corresponds to that weight or quantity of the load item which will remain in the aircraft.

(3) The reading on the index scale now under the hairline is the running index corresponding to the original aircraft condition minus the specific load item.

NOTE

For the partial expenditure of some items (such as fuel), it may be easier to remove the entire item index contribution, and then re-enter the index contribution of the remaining portion.

c. Most Forward And Aft C.G.'s. Before computing the Form F most forward and most aft c.g.'s, it is necessary to determine what configurations will produce these conditions for the specific mission. The determination requires a clear understanding of the principles and procedures described in Section VI, as well as the loading and expenditure data and requirements for the type/model/series/tail number aircraft and the specific mission. Once the most forward and aft c.g. configurations are determined the c.g.'s can be computed. By using the procedures described in 7-6a and 7-6b, add or expend stores, ammo, fuel, etc., to or from any previously computed weight and index of that specific mission. The c.g. can then be read by moving the slide and reading the c.g. at the intersection of the hairline and the computed gross weight on the loading scale.

d. Corrections. Corrections are accomplished on the Form F in much the same way as described in 7-6c. The effect of the load items to be added or removed is computed by applying the procedures described in 7-6a and 7-6b to the weight and index to be corrected. The corrected c.g. is read by moving the slide and reading the c.g. at the intersection of the hairline and the corrected weight on the loading scale. The loading scale also indicates if the corrected c.g. lies within the Safe (white), Caution (yellow), or Danger (red) loading ranges.

APPENDIX 1

DEFINITIONS

Aft Center of Gravity Limit.

The aft center of gravity limit is the most rearward permissible aircraft center of gravity location for a specific weight and configuration.

Aircraft Weighing Record. Chart B, DD Form 365B (DD Form 365-2).

An Aircraft Weighing Record, DD Form 365B (DD Form 365-2), is the form used to record data obtained from aircraft actual weighings.

Allowable Gross Weights.

The allowable weight is the not to be exceeded weight of a loaded aircraft. The aircraft's appropriate flight manuals, (i.e., NATOPS Flight Manual) specify allowable weights for particular configurations or conditions. Some examples are allowable takeoff weight, allowable landing weight, and allowable limiting wing fuel weight.

Arm.

An arm is the distance of a weight from a reference datum.

Balance.

Balance is a condition of stability which exists in an aircraft when all weights and forces are acting in such a way as to prevent rotation.

Balance Arm.

The balance arm is the arm at which a number of weights could be concentrated to produce the same effect as they produced when separated. The balance arm results from dividing the total moment by the total weight, or by using the final load adjuster index and the total weight with the aircraft's index formula.

Balance Computer.

A balance computer is a calculating device, mechanical or electronic, which is used to determine the aircraft center of gravity location for any flight or ground configuration (See Load Adjuster).

Ballast.

Ballast is any weight put in an aircraft to balance the aircraft so as to remain within the aircraft's permissible center of gravity limits.

Basic Arm.

The basic arm is the distance from the reference datum to the aircraft's basic weight center of gravity. Basic arm is determined by dividing the aircraft basic moment by the aircraft basic weight, or by using the basic load adjuster index and the basic weight with the aircraft's index formula.

Basic Index.

The basic index is a number which represents a basic moment on an aircraft's load adjuster.

Basic Moment.

The basic moment is the sum of the moments of all items included in the aircraft basic weight.

Basic Weight.

Basic weight is the sum of weight empty and weights of non-Chart E items. Examples of items in basic weight may be guns, unusable fuel, oil, ballast, survivial kits, oxygen, and internal and external equipment not disposed of during flight. An aircraft's current basic weight is the last entry in the "Current Total Basic Aircraft" column on the Chart C.

Basic Weight and Balance Record. Chart C, DD Form 365C (DD Form 365-3).

The basic weight and balance record is a continuous series of DD Form 365C (DD Form 365-3), referred to as Chart C. It is a continuous and permanent record of aircraft weight, moment and load adjuster index or center of gravity position.

Basic Weight Check List. Chart A, DD Form 365A (DD Form 365-1).

The basic weight check list is a completed collection of DD Form 365A (DD Form 365-1), referred to as Chart A. It is a list of equipment by aircraft compartment which is, or can be, installed in the aircraft.

Buttlines.

Buttlines are reference locations in either lateral (left or right) direction from the aircraft longitudinal (forward to rearward) reference datum which is usually the aircraft centerline.

C.G.

C.G. (C.G., c.g.) is an abbreviation of center of gravity.

Caution Range.

A caution range is a region of a weight and center of gravity diagram, or table, which indicates reduced aircraft capabilities, such as aircraft control or structural limitations.

Center of Gravity.

The center of gravity, c.g., is that point at which an item's weight may be assumed to be concentrated and about which the item would balance if suspended.

Chart A.

See Basic Weight Check List.

Chart C.

See Basic Weight and Balance Record.

Chart E.

See Loading Data.

Chord.

A chord is an imaginary straight line joining the leading and trailing edges of an airfoil (such as a wing or tail).

Configuration.

Configuration is a particular arrangement and quantity of structure, systems, internal and external equipment, stores, fuel, and other items, and the positions of such things as wings, slats, flaps, and landing gear.

Danger Range.

A danger range is a region of a weight and center of gravity diagram, or table, within which flight and/or ground operation of an aircraft is not permitted.

DD Form 365.

See Record of Weight and Balance Personnel.

DD Form 365A (DD Form 365-1).

See Basic Weight Check List.

DD Form 365B (DD Form 365-2).

See Aircraft Weighing Record.

DD Form 365C (DD Form 365-3).

See Basic Weight and Balance Record.

DD Form 365F (DD Form 365-4).

See Weight and Balance Clearance Form.

Drainable Fuel.

Drainable fuel is that portion of the fuel that can be drained out of an aircraft through drain points after defueling in accordance with appropriate instructions.

Flight Gross Weight.

Flight gross weight is the weight of the aircraft, its contents, and external items during flight. It is also known as flight weight and inflight weight.

Floor Loading.

Floor loading is the weight of a load divided by the area of the floor upon which the weight is placed. Specific aircraft NATOPS FLIGHT MANUALS will usually specify floor loading limits and total load capacity for various compartments of the aircraft.

Form B.

See Airplane Weighing Record.

Form F.

See Weight and Balance Clearance Form.

Forward Center of Gravity Limit.

The forward center of gravity limit is the most forward permissible aircraft center of gravity location for a specific weight and configuration.

Fulcrum.

A fulcrum is a pivot or support about which items can be balanced or rotated.

Fuselage Station.

Fuselage stations are reference locations on the aircraft in the longitudinal direction, increasing from forward to aft.

Gross Weight.

Gross weight is the total weight of an aircraft, including its contents and externally mounted items, at any time. The gross weight is continually changing throughout flight and/or ground operations.

Index.

See Load Adjuster Index.

Jig Points.

A jig point is a hole, fitting, or other fixture which is the same known distance from each reference datum for all aircraft of the same model designation.

Landing Gross Weight.

Landing gross weight is the weight of the aircraft, its contents, and external items when the aircraft lands. It is also known as landing weight.

LEMAC.

LEMAC is an abbreviation for Leading Edge of the Mean Aerodynamic Chord. The LEMAC is usually identified as the distance from the longitudinal reference datum to the leading edge of the MAC.

Leveling Lugs.

Leveling lugs are fixtures attached to the aircraft to support a spirit level or inclinometer when leveling the aircraft.

Leveling Plate.

A leveling plate is a target with index markings which is attached to the aircraft and is used with a plumb bob when leveling the aircraft.

Load Adjuster.

A load adjuster is a slide rule type mechanical balance computer.

Load Adjuster Index.

A load adjuster index is a number which represents moment on the aircraft's load adjuster and, in conjunction with aircraft weight and/or index formula, permits center of gravity calculations.

Loading Control.

Loading Control, as used in weight and balance, is the use of weight and balance forms and loading data to assure that the aircraft weight, center of gravity, and any other limits are not exceeded during flight or ground operations.

Loading Data. Chart E

Loading Data is included in the aircraft NA 01-1B-40 Technical Manual, Weight and Balance Data. They contain instructions for aircraft actual weighings, aircraft diagrams, loading limits, general instructions affecting aircraft loading, and the weight, arm and moment/index information necessary to perform loading control.

Loading Limits.

Loading limits are restrictions, such as permissible center of gravity range, floor loading, compartment capacity, and gross weight, beyond which aircraft loading is not permitted.

MAC.

The Mean Aerodynamic Chord, MAC, is an engineering term which represents an airfoil's chord in aircraft design. As such, it is a constant length which is also used in the calculation of center of gravity location in terms of percent MAC.

Maximum Gross Weight.

See Allowable Gross Weight.

Maximum Zero Fuel Weight (MZFW).

Maximum zero fuel weight is the maximum permissible weight of the loaded aircraft before any usuable fuel is added.

Moment.

Moment is a measure of the rotational tendency of a weight about a point. The moment of an item is the item's weight multiplied by its arm.

Moment Arm.

See Arm.

Negligible Change.

Negligible change is any weight change of 5 lbs of basic weight or less and/or any moment change which moves the center of gravity 0.1 percent of the MAC, 0.1 inch for rotorcraft, or less. Chart A items shall never be considered negligible.

NAVAIR 01-1B-50

Operating Weight.

Operating weight is the sum of aircraft basic weight and such things as crew, crew baggage, steward equipment, emergency equipment, special mission fixed equipment, pylon and racks not in basic weight, and othe nonexpendable items.

Operating Weight Empty/Operating Empty Weight.

Operating weight empty and operating empty weight are variously defined civil aviation terms which differ from and are not to be confused with the Air Force term operating weight.

Payload.

Payload is any item which is being transported and is directly related to the purpose of the flight as opposed to items that are necessary for the flight operation. Payload can include, but is not limted to, passengers, cargo, passenger baggage, ammo, internal and external stores, and fuel which is to be delivered to another aircraft or site.

Percent MAC.

Percent MAC expresses a location as a percentage of the mean aerodynamic chord.

Permanent Ballast.

Permanent ballast is ballast which is required to be in the aircraft at all times.

Permissible Gross Weight.

See Allowable Gross Weight.

Record of Weight and Balance Personnel. DD Form 365.

The Record of Weight and Balance Personnel, DD Form 365, is the form used to provide a permanent continuous record of weight and balance personnel responsible for maintaining the aircraft weight and balance handbooks.

Reference Datum.

A reference datum is a zero reference position from which distances are measured. Aircraft have three zero reference datums from which aircraft locations are measured in the longitudinal (using fuselage station), lateral (using buttlines), and vertical (using waterlines) directions. The longitudinal reference is usually forward of the nose. The lateral reference is usually the aircraft's center line, and the vertical reference is usually below the main wheels.

Representative Aircraft.

A representative aircraft is one chosen as being typical of a number of aircraft of the same Type/Model/Series with similar structures, systems, and equipment configurations. Usually they are in the same production lot during manufacturing.

Scale Correction Factor.

A scale correction factor is used to modify weighing scale readings because of inherent inaccuracies of the scale. Such factors may be, but are not limited to: calibration correction factors with the use of mechanical scales, load cell correction factors when the load cell readings do not return to zero after unloading with the use of electronic scales, or gravitational correction factors which depend upon the latitude of the earth. Refer to the scale's applicable calibration curve for the appropriate factors.

Operating Weight.

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Operating Weight Empty/Operating Empty Weight.

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Service Weight Pick-Up.

Service weight pick-up is the known and unknown weight change due to items such as repairs, paint, modifications, wear, dirt, moisture, and unaccountable weight.

Simplified Moment.

Simplified moment is a moment divided by an established constant such as 100, 1000, 10,000, or 100,000. Generally used for weight and balance calculations as moment/1000.

Takeoff Gross Weight.

Takeoff gross weight is the gross weight of the aircraft at the time the aircraft becomes airborne.

Tare.

Tare is the weight of equipment necessary for weighing the aircraft, such as chocks, blocks, slings, and jacks, which is included in the scale reading but is not part of the aircraft weight. It also can include a Scale Correction Factor.

Temporary Ballast.

Temporary ballast is used to replace missing items, such as crew members, armament, and equipment, in order to maintain the aircraft center of gravity within limits and/or to simulate a specific aircraft configuration.

Trapped Fuel.

Trapped fuel is the fuel that remains in an aircraft after utilizing applicable prescribed methods to defuel the aircraft and drain individual tanks and lines.

Unaccountable Weight or Moment.

Unaccountable weight or moment is any change in basic weight which is not reflected by an entry in the Chart C.

Unusable Fuel.

Unusable fuel is the fuel remaining in the aircraft after engine fuel starvation when the aircraft is in the specified flight attitude.

Waterline.

Waterlines are locations in the vertical (up and down) direction measured from a reference datum which is usually well below the aircraft.

Weighing Reaction Points.

Weighing reaction points are those points upon which the aircraft's weight is supported during weighing.

Weight and Balance Clearance Form. Chart F, DD Form 365F (DD Form 365-4).

The Weight and Balance Clearance form, DD Form 365F (DD Form 365-4), is referred to as Form F. Tactical and transport Form 4's record weight, moment or index, and center of gravity calculations to ensure the aircraft remains within its weight and balance limitations.

Weight and Balance Handbook.

An aircraft weight and balance handbook is a continuous and permanent record of weight and balance of a particular aircraft. It is identified on Navy aircraft as NA 01-1B-40 and contains weighing instructions, blank copies of DD 365 forms and form completion instructions.

Weight Empty.

Weight empty is an engineering term which is defined for aircraft design and does not effect operational activities. It is the weight of the aircraft, complete per model definitions, dry, clean, and empty except for fluids in closed systems such as a hydraulic system.

Zero Fuel Weight (ZFW).

Zero Fuel Weight is the weight of the loaded aircraft without any usuable fuel. See also Maximum Zero Fuel Weight.

APPENDIX 2

CHARTS AND FORMS

RECORD OF WEIGHT AND BALANCE PERSONNEL

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

AIRPLANE MODEL	SERIAL NUMBER

NAME	GRADE	STATION	DATE ASSIGNED	DATE RELIEVED

DD FORM 1 SEPT 54 365 Previous editions of this form may be used until stocks are exhausted. 16—70637-1 U. S. GOVERNMENT PRINTING OFFICE

RECORD OF WEIGHT AND BALANCE PERSONNEL				FOR USE IN T. O. 1-1B-40 & AN 01-1B-40
AIRPLANE MODEL		SERIAL NUMBER		
NAME	GRADE	STATION	DATE ASSIGNED	DATE RELIEVED

DD FORM 1 SEPT 54 365

	FOR USE IN T O 1-1B-40 & AN 01-1B-40
DELIVERY DATE	RECORD OF CHECKING *(Enter date)*

CHART A – BASIC WEIGHT CHECK LIST

PAGE OF PAGES	AIRPLANE MODEL	SERIAL NUMBER

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION *(Grouped by Compartment)*	WEIGHT	ARM	1/ MOMENT	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	1 CHART C ENTRY	2 IN AIRPLANE	2 CHART C ENTRY	3 IN AIRPLANE	3 CHART C ENTRY	4 IN AIRPLANE	4 CHART C ENTRY	5 IN AIRPLANE	5 CHART C ENTRY	6 IN AIRPLANE	6 CHART C ENTRY	7 IN AIRPLANE	7 CHART C ENTRY	8 IN AIRPLANE	8 CHART C ENTRY

1/ Enter constant used below line.

DD FORM 1 SEPT 54 365A Previous editions of this form may be used until stocks are exhausted.

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

CHART A - BASIC WEIGHT CHECK LIST

PAGE OF PAGES | AIRPLANE MODEL | SERIAL NUMBER | DELIVERY DATE | RECORD OF CHECKING *(Enter date)*

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION *(Grouped by Compartment)*	WEIGHT	ARM	1/ MOMENT	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	2 IN AIRPLANE	2 CHART C ENTRY	3 IN AIRPLANE	3 CHART C ENTRY	4 IN AIRPLANE	4 CHART C ENTRY	5 IN AIRPLANE	5 CHART C ENTRY	6 IN AIRPLANE	6 CHART C ENTRY	7 IN AIRPLANE	7 CHART C ENTRY	8 IN AIRPLANE	8 CHART C ENTRY

1/ *Enter constant used below line.*

DD FORM 1 SEPT 54 365A   Previous editions of this form may be used until stocks are exhausted.

AIRPLANE WEIGHING RECORD

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

DATE WEIGHED	MODEL	SERIAL NUMBER

PLACE WEIGHED	WEIGHING PERSONNEL

REACTION *(Wheels, jackpoints, etc.)*	SCALE READING	TARE	NET WEIGHT	ARM	MOMENT
LEFT MAIN					
RIGHT MAIN					
SUB-TOTAL *(Both Main)*				E	
NOSE OR TAIL				F	
TOTAL *(As Weighed)*				H	

MEASUREMENTS

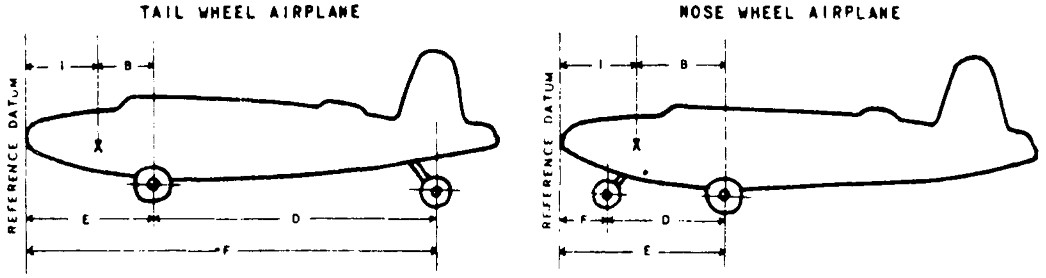
B = ____________ the distance from the jig point, to the center line of the main reactions. Obtain by measurement.

I = ____________ the distance from the reference datum to the jig point of the airplane, from which a plumb bob can be dropped to the ground. Obtain from the airplane diagram in Chart E.

E = ____________ 1/ the distance from the reference datum to the center line of the main reactions.
E = I + B
E = I - B *(If the jig point is aft of the center line of the main reactions.)*

D = ____________ the wheel base *(or the distance between fore and aft reactions.)* Obtain by measurement.

F = ____________ 1/ the distance from the reference datum to the center line of the nose or tail reaction.
F = E - D *(For nose wheel type aircraft)*
F = E + D *(For tail wheel type aircraft)*



DIAGRAMS FOR MEASURING VARIOUS TYPES OF AIRPLANES TO DETERMINE ARM OF SUPPORT POINTS.

1/ Check dimensions E and F against approximate dimensions listed on Chart E.

DD FORM 1 SEPT 54 365B Previous editions of this form may be used until stocks are exhausted.

AIRPLANE WEIGHING RECORD				FOR USE IN T.O. 1-1B-40 & AN 01-1B-40
DESCRIPTION	NET WEIGHT	ARM	MOMENT	1/ INDEX OR MOM/
TOTAL *(As Weighed)*				
OIL IN AIRPLANE	−		−	
TOTAL OF ITEMS WEIGHED BUT NOT PART OF BASIC WEIGHT *(From Col. I below)*	−		−	
TOTAL OF BASIC ITEMS NOT IN AIRCRAFT WHEN WEIGHED *(From Col. II below)*	+		+	
BASIC AIRPLANE *(Post to Chart C)*				

COLUMN I				COLUMN II			
ITEMS WEIGHED BUT NOT PART OF BASIC WEIGHT	WEIGHT	ARM	MOMENT	BASIC ITEMS NOT IN AIRPLANE WHEN WEIGHED	WEIGHT	ARM	MOMENT
TOTAL				TOTAL			

REACTIONS USED	TYPE SCALES

REMARKS

1/ Enter constant used.

CHART C—BASIC WEIGHT AND BALANCE RECORD

(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

AIRPLANE MODEL | SERIAL NO. | PAGE NO.

DATE	ITEM NO.		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						RUNNING TOTAL BASIC AIRPLANE		
				ADDED (+)			REMOVED (−)					
	IN	OUT		WEIGHT	ARM	MOMENT [1]	WEIGHT	ARM	MOMENT [1]	WEIGHT	MOMENT [1]	INDEX [2]

[1] *Enter constant used below line.* [2] *Balance computer index.*

DD FORM 1 SEP 54 365C

PREVIOUS EDITIONS OF THIS FORM MAY BE USED UNTIL STOCKS ARE EXHAUSTED.

16—70874-1 U. S. GOVERNMENT PRINTING OFFICE

CHART C—BASIC WEIGHT AND BALANCE RECORD

(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

AIRPLANE MODEL	SERIAL NO.	PAGE NO.

DATE	ITEM NO.		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						RUNNING TOTAL BASIC AIRPLANE		
				ADDED (+)			REMOVED (−)					
	IN	OUT		WEIGHT	ARM	MOMENT[1]	WEIGHT	ARM	MOMENT[1]	WEIGHT	MOMENT[1]	INDEX[2]

[1] *Enter constant used below line.* [2] *Balance computer index.*

DD FORM 1 SEP 54 365 C PREVIOUS EDITIONS OF THIS FORM MAY BE USED UNTIL STOCKS ARE EXHAUSTED. 16—70874-1 U. S. GOVERNMENT PRINTING OFFICE

WEIGHT AND BALANCE CLEARANCE FORM F

TRANSPORT

(USE REVERSE FOR TACTICAL MISSIONS)

Cross Reference RAF Form 2870 RCAF Form F. 115 C 50M 5-51 (6797)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

DATE	AIRCRAFT TYPE	FROM	HOME STATION
MISSION/TRIP/FLIGHT/NO.	SERIAL NO.	TO	PILOT

LIMITATIONS			
CONDITION	TAKEOFF	LANDING	LIMITING WING FUEL
[2] ALLOWABLE GROSS WEIGHT			
TOTAL AIRCRAFT WEIGHT (*Ref. 11*)			
OPERATING WEIGHT PLUS ESTIMATED LANDING FUEL WEIGHT			
OPERATING WEIGHT (*Ref. 8*)			
ALLOWABLE LOAD (*Ref. 12*) (*use SMALLEST figure*)			
[3] PERMISSIBLE C. G. TAKEOFF	FROM	TO (% *M.A.C. or IN.*)	
[4] PERMISSIBLE C. G. LANDING	FROM	TO (% *M.A.C. or IN.*)	
[5] LANDING FUEL WEIGHT			

REF	ITEM	WEIGHT	[1] INDEX OR MOM/
1	BASIC AIRCRAFT (*From Chart C*)		
2	OIL (*Gal.*)		
3	CREW (*No.*)		
4	CREW'S BAGGAGE		
5	STEWARD'S EQUIPMENT		
6	EMERGENCY EQUIPMENT		
7	EXTRA EQUIPMENT		
8	OPERATING WEIGHT		
9	TAKEOFF FUEL (*Gal.*)		
10	WATER INJ. FLUID (*Gal.*)		
11	TOTAL AIRCRAFT WEIGHT		

12 DISTRIBUTION OF ALLOWABLE LOAD (PAYLOAD)

COMPT	UPPER COMPARTMENTS PASSENGERS NO	WEIGHT	CARGO	COMPT	LOWER COMPARTMENTS PASSENGERS NO	WEIGHT	CARGO	WEIGHT	INDEX OR MOM/
A									
B									
C									
D									
E									
F									
G									
H									
I									
J									
K									
L									
M									
N									
O									
P									
FWD	BELLY								
AFT	BELLY								

REMARKS

TOTAL FREIGHT	
TOTAL MAIL	

COMPUTER PLATE NUMBER (*If used*)

[1] *Enter constant used.*
[2] *Enter values from current applicable T. O.*
[3] *Applicable to gross weight (Ref. 15).*
[4] *Applicable to gross weight (Ref. 20).*
[5] *Ref. 9 minus Ref. 17.*

CORRECTIONS (*Ref. 14*)

COMPT	ITEM	CHANGES (+ or −) WEIGHT	[1] INDEX OR MOM/
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE (*Ref. 14*)			

REF	ITEM	WEIGHT	INDEX OR MOM/
13	TAKEOFF CONDITION (*Uncorrected*)		
14	CORRECTIONS (*If required*)		
15	TAKEOFF CONDITION (*Corrected*)		
16	TAKEOFF C. G. IN % M. A. C. OR IN.		
17	LESS FUEL		
18	LESS AIR SUPPLY LOAD DROPPED		
19	MISC. VARIABLES		
20	ESTIMATED LANDING CONDITION		
21	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.		

COMPUTED BY

SIGNATURE

WEIGHT AND BALANCE AUTHORITY

SIGNATURE

PILOT

SIGNATURE

NOTE.—THIS TRANSPORT CLEARANCE FORM HAS RESULTED FROM TRIPARTITE AGREEMENT AND NO FURTHER CHANGES MAY BE MADE TO IT WITHOUT PRIOR CONSIDERATION BY TRIPARTITE AUTHORITIES.

DD FORM 1 SEPT 54 365F

16—67910-5

WEIGHT AND BALANCE CLEARANCE FORM F

TACTICAL

(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

DATE	AIRCRAFT TYPE	FROM	HOME STATION
MISSION/TRIP/FLIGHT/NO.	SERIAL NO.	TO	PILOT

REMARKS

COMPUTER PLATE NO. *(If used)*

Pertinent instructions to the pilot for shifting load and crew during takeoff and landing should be noted above.

REF	ITEM					WEIGHT	[1] INDEX OR MOM/
1	BASIC AIRCRAFT *(From Chart C)*						
2	OIL (Gal.)						
3	DISTRIBUTION OF LOAD						
	COMPT.	CREW NO.	CREW WEIGHT	BAGGAGE	CARGO AND MISC.		
4	OPERATING WEIGHT						
5	AMMUNITION: COMPT.	ROUNDS	CALIBER				
6	BOMBS, ROCKETS, ETC.: FORWARD						
	AFT						
	EXTERNAL						
	ROCKETS						
7	FUEL: BUILT IN (Gal.)						
	BOMB BAY (Gal.)						
	EXTERNAL (Gal.)						
8	WATER INJ. FLUID (Gal.)						
9	JATO OR RATO						
10	TAKEOFF CONDITION *(Uncorrected)*						
11	CORRECTIONS *(If required)*						
12	TAKEOFF CONDITION *(Corrected)*						
13	TAKEOFF C. G. IN % M. A. C. OR IN.						
14	LESS EXPENDABLES: JATO OR RATO						
	BOMBS						
	AMMUNITION						
	FUEL						
15	ESTIMATED LANDING CONDITION						
16	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.						

CORRECTIONS *(Ref. 11)*

COMPT.	ITEM	CHANGES (+ or −) WEIGHT	CHANGES (+ or −) [1] INDEX OR MOM/
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE *(Ref. 11)*			

LIMITATIONS

[2] GROSS WT. TAKEOFF *(lb.)*		[2] GROSS WT. LANDING *(lb.)*
[3] PERMISSIBLE C. G. TAKEOFF	FROM	TO (% M. A. C. or IN.)
[4] PERMISSIBLE C. G. LANDING	FROM	TO (% M. A. C. or IN.)

COMPUTED BY *(Signature)*

WEIGHT AND BALANCE AUTHORITY *(Signature)*

PILOT *(Signature)*

[1] *Enter constant used.*
[2] *Enter values from current applicable T. O.*
[3] *Applicable to gross weight (Ref. 12).*
[4] *Applicable to gross weight (Ref. 15).*

DD FORM 1 SEPT 54 365F

16—67910—4

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