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AIR FORCE TO 1-1B-50
COAST GUARD TO 1-1B-50
ARMY TM 55-1500-342-23

See Supplement D, 13 JUNE 2024

JOINT SERVICE TECHNICAL MANUAL

ORGANIZATIONAL, INTERMEDIATE, AND DEPOT MAINTENANCE

AIRCRAFT WEIGHT AND BALANCE

SUPERSEDURE NOTICE. This manual supersedes NAVAIR 01-1B-50 dated 01 August 2019, USAF TO 1-1B-50 dated 01 August 2019, USCG TO 1-1B-50 dated 01 August 2019, and ARMY TM 55-1500-342-23 dated 01 August 2019. Destroy previously issued versions of these manuals to prevent disclosure of contents or reconstruction of the documents.

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CHAPTER 1
INTRODUCTION

1.1 PURPOSE. This manual outlines and defines the requirements, procedures, and responsibilities for weight and balance control of military aircraft. This manual also provides information and instructions for maintaining the charts and forms (DD Form 365 series or electronic equivalent) that provide the means for maintaining continuous record and control of aircraft weight and balance. Information and explanation of principles, terms, and definitions are 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 units and organizations that either operate or maintain United States military aircraft, including fixed-wing and rotary-wing aircraft and select unmanned air vehicles. Each service's Engineering Organization for weight and balance may approve alternate methods of compliance with this technical manual. See Chapter 8 - Service Specific Requirements for additional information concerning select unmanned air vehicles [Army 8.1.10; Navy 8.2.6; Air Force 8.3.12; USCG 8.4]. Also included is a complete description of related equipment and instructions for its use and operation. The general requirements and procedures of this manual are applicable to weight and balance control of all military aircraft. Additional requirements, procedures, and/ or instructions for specific aircraft weight and balance control are specified in the aircraft specific manuals. See Chapter 8 - Service Specific Requirements for additional reference documents.

1.3 TERMINOLOGY

1.3.1 Usage of the words "shall", "should", and "may" is in accordance with the following:

1.3.2 The word "shall," is used to indicate the requirements, procedures, and/or responsibilities are mandatory.

1.3.3 The word "should" is used to indicate a non-mandatory but highly recommended method of accomplishment.

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

1.3.5 Weight and balance terminology and definitions are found in Appendix A. Acronyms are found in Appendix B.

1.3.6 Warnings, Cautions, and Notes Defined. Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

1.3.6.1 WARNING: An essential operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in injury to, or death of, personnel or long term health hazards.

1.3.6.2 CAUTION: An essential operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in damage to or destruction of, equipment or loss of mission effectiveness.

1.3.6.3 NOTE: An essential operating or maintenance procedure or condition that must be emphasized.

1.4 REASONS FOR WEIGHT AND BALANCE CONTROL. Since flight characteristics of aircraft are directly dependent upon conditions of weight and balance, using the principles and following the instructions contained in this manual can prevent dangerous flight conditions and potential associated mishaps. Gross Weight and center of gravity (CG) have a bearing on performance, stability, and control of the aircraft. For example, cargo placed too far aft in an already critically loaded aircraft could move the center of gravity out of the permissible balance limits. This could cause the pilot to lose control of the aircraft. Hazardous flight conditions and accidents resulting from these conditions can be prevented by adherence to the principles of weight and balance set forth in this manual. An aircraft whose weight is greater than its allowable maximum Gross Weight, or whose CG is located outside its prescribed CG limits, may experience one or more of the following unsatisfactory flight characteristics, performance degradations or payload reduction:

a. Longitudinal instability.

b. Lateral instability.

c. Increase in takeoff distance.

d. Increase in required power setting or torque.

e. Increase in takeoff or landing speed.

f. Increase in landing ground run.

g. Increase in control forces.

h. Increase in stall speeds.

i. Decrease in range.

j. Decrease in allowable payload.

k. Decrease in rate of climb.

l. Decrease in service ceiling.

m. Decrease in structural safety factors.

n. Decreased hover performance.

o. Decreased cruising speed.

p. Decreased maneuverability.

1.5 COMMENTS. See Chapter 8 - Service Specific Requirements for Points of Contact for each service [Army 8.1.12; Navy 8.2.12; Air Force 8.3.15; USCG 8.4].

CHAPTER 2
AIRCRAFT WEIGHT AND BALANCE PRINCIPLES

2.1 AIRCRAFT WEIGHT PRINCIPLES. One of the basic elements of aircraft design is weight. The weight of an aircraft is used in determining such design criteria as engine requirements, wing area, landing gear requirements, and payload capacity. Any weight changes, whether in manufacturing, modification, or maintenance, can have distinct effects on aircraft performance and/or payload capability.

2.1.1 Weight Terminology. Figure 2-1 illustrates the definition of, and relationships between, aircraft weight terminology. For related definitions, see Appendix A.

2.1.2 Weight Limits. All aircraft are designed with a number of weight limits. These limits are determined by a combination of performance, control, and structural restrictions. Exceeding these limits can result in loss of aircraft and is expressly forbidden.

2.1.3 Aircraft Weight. The weight of an aircraft is determined through a combination of actual weighing, accurate record keeping, and proper use of the aircraft specific manuals, charts, forms, and loading manuals.

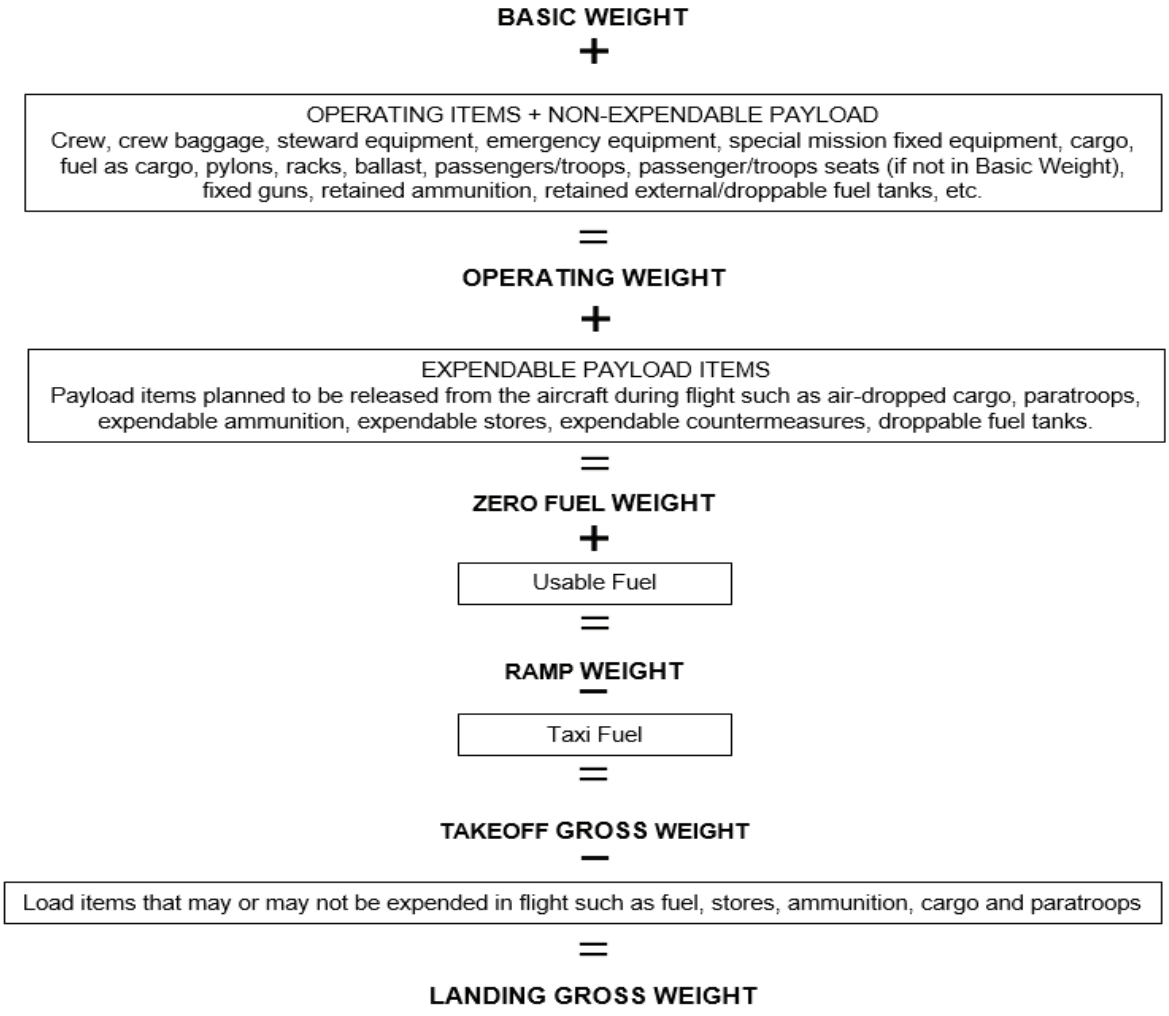
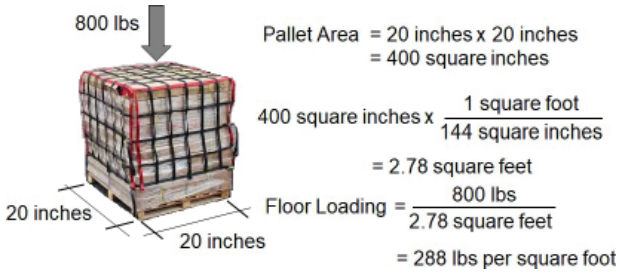


Figure 2-1. Weight Terminology

2.1.4 Floor Loading. Floor loading is the weight, in pounds, of a load divided by the area of floor on which the load rests. These limits shall never be exceeded.

2.1.4.1 For example, the floor loading for a 800-pound container is determined as follows:



Floor loading limits or a plan view of the cargo floor showing variations in floor strength and weight concentration limitations for various compartments are specified in the applicable operator's manual.

NOTE

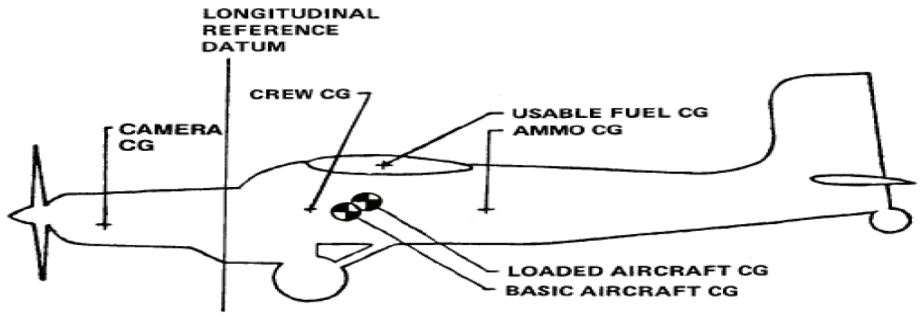
1 square foot = 144 square inches.

2.2 AIRCRAFT BALANCE PRINCIPLES. 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 Center of Gravity (CG) of the aircraft is within allowable CG limits. These limits are defined by the most forward and aft permissible CG locations and are called the forward and aft CG limits, respectively. To determine if an aircraft is balanced, the aircraft CG shall be calculated and compared to the forward and aft CG limits for that particular configuration and Gross Weight. The CG can be calculated in the longitudinal, lateral, and vertical directions. Refer to aircraft specific manuals for CG limits

2.2.1 Terminology. The terms balance, arm, balance arm, moment, simplified moment, load adjuster index, and Center of Gravity are fundamental to understanding aircraft balance and control. These, and other terms used in this Chapter, are defined in Appendix A.

2.3 CALCULATING AIRCRAFT CENTER OF GRAVITY. The CG of a loaded aircraft can be calculated when the weights and arms and/or moments of the items which make up the aircraft Gross Weight are known (see Figure 2-2). The relationship between weight, arm and moment is as follows:

WEIGHT × ARM = MOMENT



	Weight (lbs)		Arm(in)		Moment(in-lbs)
Basic Weight	3,596				212,989
Camera	12	x	-64.8	=	-778
Crew	200	x	42.1	=	8,420
Usable Fuel	900	x	73.4	=	66,060
Ammo	340	x	122.2	=	41,548
	5,048				328,239

Total Moment ÷ Total Weight = Balance Arm

328,239 in-lbs ÷ 5,048 lbs = 65.0 in

Figure 2-2 Calculating Aircraft CG

2.3.1 It is important to note that arms may not be added or subtracted when calculating CG. CG is calculated by taking the summation of total moments divided by the summation of total weights. Weights can be added or subtracted and moments can be added or subtracted but arms cannot be added or subtracted.

2.4 FUSELAGE STATION. Fuselage Station (FS) is frequently synonymous to the balance arm scale. However, if the aircraft fuselage is shortened or lengthened, the original fuselage sections usually retain their old FS designations but will have different balance arms. This alters the FS–balance arm relationship (see Figure 2-3). The balance arm is what is used in the moment calculation formula. A fuselage plug can result in items being located ahead of the reference datum, leading to negative balance arms, as in Figure 2-3.

2.4.1 Balance calculations shall be made using balance arms; not FS locations. For those aircraft whose fuselage station differs from its balance arm, the aircraft-specific loading manual will provide a conversion table and further details.

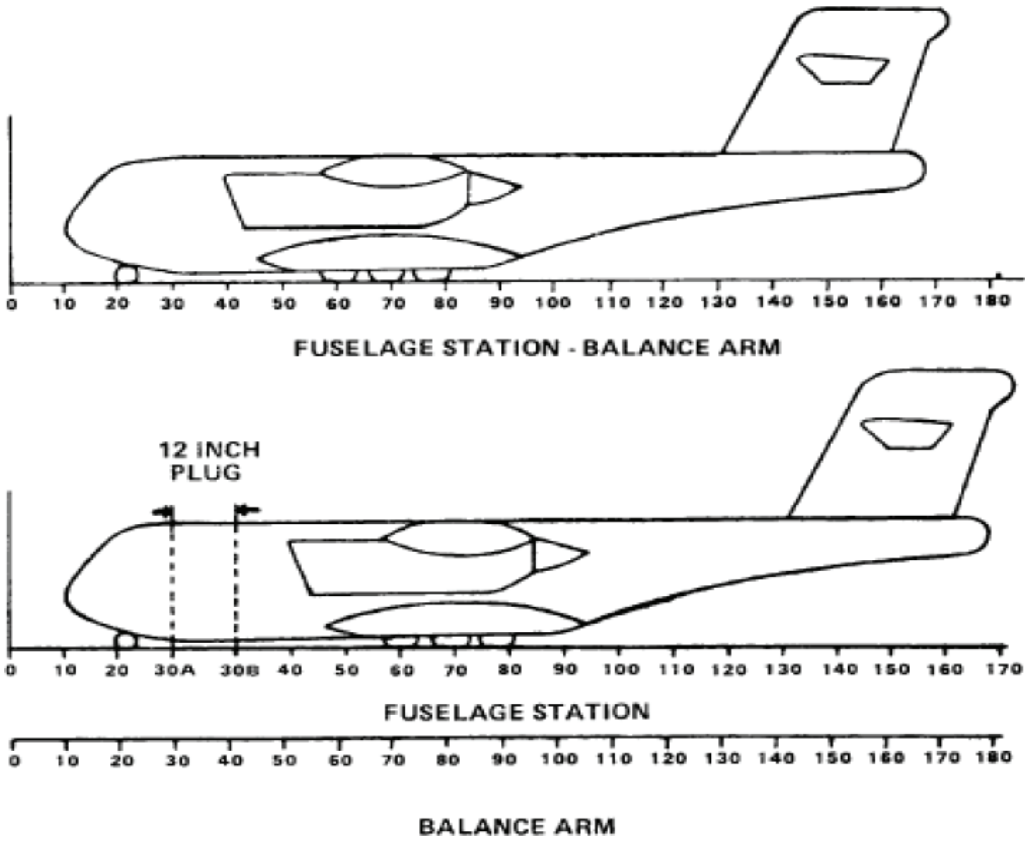
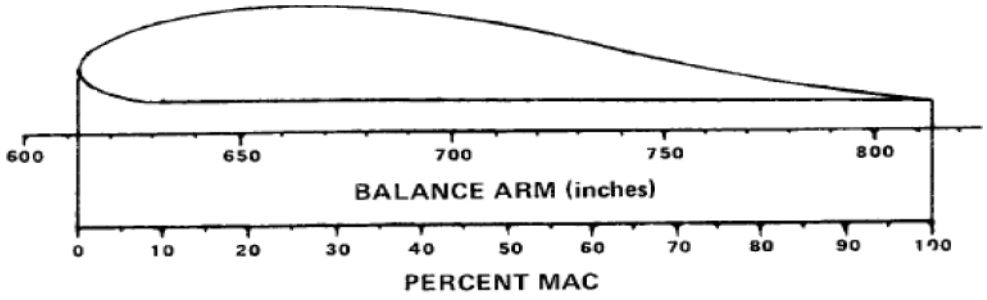


Figure 2-3. Balance Arm Fuselage Station

2.5 PERCENT MEAN AERODYNAMIC CHORD (% MAC). In fixed-wing aircraft, the location of the aircraft CG is commonly expressed by %MAC instead of by its balance arm. The Mean Aerodynamic Chord (MAC) is an overall average chord, representative of an entire wing, used in aerodynamic computations and analysis. Expressing the CG in %MAC identifies where the CG is relative to this mean chord of the wing. Zero % MAC is the leading edge of the average chord and 100 %MAC is the trailing edge of the average chord. For definitions, see Appendix A. For weight and balance purposes, %MAC is found by a simple mathematical conversion equation or tables particular to the aircraft type, and is listed in the aircraft-specific loading manual. (See Figure 2-4).

2.6 LOADING / UNLOADING. The loading or 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 weight. Balance loading principles and the techniques for determining the CG for various aircraft configurations are discussed in Chapter 7 (Center of Gravity Loading Calculations).

2.7 BALLAST. There are two types of concentrated masses, permanent ballast and temporary ballast that can have a profound effect on aircraft balance and therefore must be accounted for accurately. Permanent ballast is required by design of the aircraft or due to modifications and must be installed before flight. Temporary ballast may be required to be installed before flight depending on operational loading conditions. For definitions of permanent and temporary ballast, see Appendix A. An equation for use in determining the amount of temporary ballast is included in Chapter 7 (Center of Gravity Loading Calculations).



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

LEMAC = 611.10 inches
MAC = 200.87 inches

$$\text{Percent MAC} = \frac{(\text{Balance Arm} - 611.10)}{\text{MAC}} \times 100$$

Figure 2-4. Percent MAC Example

CHAPTER 3
WEIGHT AND BALANCE SYSTEM

3.1 GENERAL. This Chapter defines the requirements, procedures and Command responsibilities relative to the US Military 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, and to maintain aircraft Gross Weight and CG within permissible limits in order to ensure safety of flight. Responsibilities for weight and balance personnel qualifications are identified in service specific portions of Chapter 8 [Army 8.1.4; Navy 8.2.3; Air Force 8.3.4; USCG 8.4].

3.2 MANUFACTURER RESPONSIBILITIES.

3.2.1 The aircraft manufacture inserts all identifyining aircraft data on the title page of the Weight and Balance Handbook and completes all other applicable charts and forms prior to delivery of the aircraft.

3.2.2 The aircraft manufacturer shall maintain and update the aircraft Weight and Balance Handbook in accordance with this manual. Any associated electronic records in equivalent format shall be updated as well prior to delivery or return to service.

3.2.3 Each service's engineering organization (technical proponent) for weight and balance may approve alternate methods, in lieu of weighing every new aircraft, for the manufacturer to establish the initial weight and center-of-gravity. (See Chapter 8 - Service Specific Requirements [Army 8.1.12; Navy 8.2.8; Air Force 8.3.9a; USCG 8.4]).

3.3 COMMERCIAL MAINTENANCE RESPONSIBILITIES. Commercial activities involved in the weight and balance control of US Military aircraft shall comply with requirements of this manual.

3.3.1 The commercial modification or maintenance facility shall maintain and update the aircraft Weight and Balance Handbook in accordance with this manual. Any associated electronic records in equivalent format shall be updated as well prior to return to service.

3.4 DEPOT / INTERMEDIATE LEVEL MAINTENANCE RESPONSIBILITIES. Depot / Intermediate level maintenance facilities shall update individual aircraft Weight and Balance records and weigh aircraft as required in accordance with the requirements of this manual and other applicable service specific documents (see Chapter 8 - Service Specific Requirements [Army 8.1.3b; Navy 8.2.3; Air Force 8.3.4b; USCG 8.4]). These facilities shall ensure that a dedicated staff of qualified personnel are available to accomplish the required tasks and shall designate the Lead Weight and Balance Specialist responsible.

3.5 AIRCRAFT CUSTODIAN/TECHNICIAN/TYPE COMMANDER RESPONSIBILITIES. Refer to Chapter 8 - Service Specific Requirements for additional clarification of responsibilities [Army 8.1.3; Navy 8.2.3; Air Force 8.3.5; USCG 8.4].

3.6 AIRCRAFT WEIGHT AND BALANCE CLASSIFICATIONS. For weight and balance control purposes, US Military aircraft are divided into the following classifications:

3.6.1 Class 1A. Class 1A aircraft are those with published weight and CG limits that cannot be exceeded by normally employed loading arrangements and therefore need no loading control.

3.6.2 Class 1B. Class 1B aircraft are those with published weight and CG limits that can be exceeded by normally employed loading arrangements and therefore need loading control.

3.6.3 Class 2. Class 2 aircraft are those with published weight and CG limits that can readily be exceeded by normally employed loading arrangements and therefore need a higher degree of loading control.

NOTE

Service-unique requirements for UAVs/UASs are addressed in Chapter 8 - Service Specific Requirements [Army 8.1.10; Navy 8.2.11; Air Force 8.3.12; USCG 8.4].

3.7 WEIGHT AND BALANCE HANDBOOKS. An aircraft weight and balance handbook provides for the continuous record of the weight and balance data for a particular aircraft. A separate handbook shall be produced and maintained for each active aircraft.

3.7.1 Maintenance of weight and balance handbooks for inactive aircraft (flyable temporary storage, static display, ground training) is not required but they should be retained. If inactive aircraft become active, the weight and balance handbook shall be updated with an actual

weighing prior to return to flight. If the weight and balance handbook is not available, one shall be initiated in accordance with paragraph 3.7.5.

3.7.2 Handbook Location. Weight and balance handbooks shall be stored as determined by the aircraft custodians/technicians, but always in a location readily available to the pilot and other personnel responsible for accomplishing weight and balance functions.

NOTE

Some aircraft may have an electronic Weight and Balance handbook.

3.7.3 Handbook Content. The weight and balance handbook shall be maintained for each assigned active aircraft by qualified weight and balance personnel. The handbook DD 365 series charts, forms and records (or electronic equivalents), shall be maintained in accordance with requirements and instructions of this manual. The contents of the weight and balance handbook shall include:

3.7.3.1 A cover page containing the aircraft type Model/ Design/Series/Type/Model/Series (MDS / TMS) and aircraft number (serial number/bureau number (BUNO) shall be used if the handbook is maintained using paper forms.

3.7.3.2 DD Form 365, Record of Weight and Balance Personnel.

3.7.3.3 DD Form 365-1, Chart A - Basic Weight Checklist Record.

3.7.3.4 DD Form 365-2, Form B - Aircraft Weighing Record.

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

3.7.3.6 Chart E - Loading Data for applicable aircraft. (See Chapter 8 - Service Specific Requirements) [Army 8.1.5a(5); Navy throughout 8.2; Air Force 8.3.2b(1)(f); USCG 8.1.1b]).

3.7.3.7 Required copies of DD Form 365-4, Weight and Balance Clearance Form F, except Class 1A aircraft.

3.7.3.8 Electronic Media. When an aircraft is transferred, the transferring activity shall ensure an AWBS data file (or equivalent) representing the current Basic Weight configuration upon transfer for that serial number aircraft in a suitable approved electronic format is included with the weight and balance handbook records transferred with the aircraft. See Chapter 8 – Service Specific Requirements for Central Server use Requirements [Army 8.1.15a, Navy 8.2.9, Air Force 8.3.14, USCG 8.4]

3.7.3.8.1 The electronic weight and balance file shall be backed up. (See Chapter 8 - Service Specific Requirements [Army 8.1.2; Navy 8.2.14; Air Force 8.3.14c; USCG 8.4]). The data file shall be backed up in a location other than that of primary storage.

3.7.4 Handbook Security Classification. Aircraft weight and balance handbooks shall be classified in accordance with the highest security classification of the data contained therein. Contact local or program security officers for additional requirements.

3.7.5 Handbook Initiation or Replacement. In the event an aircraft weight and balance handbook or pages become lost, damaged, or for any reason need to be initiated or replaced, the individual assigned responsibility for that aircraft weight and balance handbook shall assemble a new handbook as follows:

3.7.5.1 A cover page inserted in a blank binder or suitable equivalent containing the aircraft type (MDS / TMS) and aircraft number (serial number/bureau number (BUNO)) shall be used if the handbook is maintained using paper forms.

3.7.5.2 Complete a new Record of Weight and Balance Personnel.

3.7.5.3 Create or obtain a new Chart A using an applicable existing Chart A or obtain a copy from the Service Engineering Organization.

3.7.5.4 Inventory the aircraft in accordance with instructions in Chapter 4 (Instructions for the use of Weight and Balance Charts and Forms).

3.7.5.5 Weigh the aircraft by an authorized source. Sources other than an authorized weighing facility shall be approved by the Service Engineering Organization. (See Chapter 8 - Service Specific Requirements [Army 8.1.12; Navy N/A; Air Force N/A; USCG 8.4]). Record the results of the weighing on a Form B.

3.7.5.6 Create a new Chart C and begin it with an initial entry reflecting the newly created Form B. Include a note identifying the reason for assembling a new handbook in the Chart C.

3.7.5.7 Copy an applicable aircraft Chart E from the handbook of another aircraft of the same TMS/MDS or obtain a copy from the Service Engineering Organization. (See Chapter 8 - Service Specific Requirements [Army 8.1.5; Navy 8.2.2.c(3); Air Force 8.3.2b(1)(f); USCG 8.4]).

3.7.5.8 Obtain and prepare required Forms F.

3.7.5.9 Create a backup of the AWBS data file (or equivalent) that contains the handbook data, once established and up-to-date.

NOTE

If sufficient data is available to accurately reflect the aircraft's lost or damaged weight and balance data pages, as in the case of worn or water damaged pages, accomplish items 3.7.4.1 through 3.7.4.9 above as deemed necessary by the individual assigned responsibility for weight and balance. This may require obtaining a recent Chart A and Form B from the last weighing and making all applicable changes to the Chart C via a complete inventory and verification of all modifications Time Compliance Technical Order/Modification Work Order/Technical Directive (TCTO/MWO/TD) made since the last weighing. This is only possible if changes since the last weighing are known with full confidence. Electronic forms data (or equivalent) can also be used to create a replacement copy of the lost paper aircraft handbook.

3.7.5.10 Authorized Substitute Forms. Hard copies of an electronic equivalent may be used in lieu of the DD Form 365 charts, forms, and records. (See Chapter 8 - Service Specific Requirements [Army N/A; Navy 8.2.14a, 8.2.7e; Air Force 8.3.2g, 8.3.2b(1)(f); USCG 8.4]).

3.7.6 Entry Errors. If errors are found on paper forms in the weight and balance handbooks, do not erase or change the entry. With paper forms, line out the erroneous entry and correct the entry. Make a note in the Chart C pertaining to the correction. With electronic forms in AWBS, add a Header in the Chart C that describes the error and fix that occurred.

3.7.7 Supply of Forms. DD 365 series manual forms are available for download in a fillable PDF document at the DOD Forms Management website at https://www.esd.whs.mil/Directives/forms/dd0001_0499/.

3.7.8 Charts / Forms / Records Disposition. Charts, Forms and Records shall be maintained in accordance with Chapter 8 - Service Specific Requirements [Army 8.1.5; Navy 8.2.5a; Air Force 8.3.6; USCG 8.4].

3.8 WEIGHT AND BALANCE FLIGHT CLEARANCE. Weight and balance clearance is required for aircraft that can exceed weight and balance limits to ensure that operations remain within proper limits during all phases of the mission from ramp/taxi to landing. Such clearance is recorded through the use of the Weight and Balance Clearance Form F, or through an authorized electronic substitute. The original copy of the Form F, when properly signed and filed in accordance with applicable procedures stated in this manual and other service directives, serve as the record to certify that weight and balance clearance was properly accomplished. (See Chapter 8 - Service Specific Requirements [Army 8.1.6; Navy 8.2.7; Air Force 8.3.8; USCG 8.4]).

3.8.1 Required Clearance. Weight and balance clearance is required for Class 1B and Class 2 aircraft.

3.8.2 Form F Maintenance Procedures. All Forms F shall be completed in accordance with the instructions of this technical manual. Forms F are utilized on a ONE TIME USE basis, or are standardized for multiple uses.

3.8.3 One Time Use Form F. These are Forms F prepared for use on a one-time basis and are kept on file for 90 days upon mission completion or in accordance with command procedures. They are used when the Command does not utilize a standardized loading approach or when an aircraft is loaded in a manner for which no standard loading Form F is on file or applicable. (See Chapter 8 - Service Specific Requirements [Army 8.1.6; Navy 8.2.7a(3);Air Force 8.3.8a(1)(a); USCG 8.4]).

3.8.4 Standardized Loading Form F. These are Forms F prepared for "repetitive use." They are filed in accordance with established Command procedures for future reference and use. Forms F based on standardized loadings shall be checked at least every 180 days for accuracy and a new Form F prepared as required. (See Chapter 8 - Service Specific Requirements [Army 8.1.6; Navy 8.2.7a(4); Air Force 8.3.8a(1)(b); USCG 8.4]). If no changes are required, the Form F may be re-dated and initialed, or a letter issued to state the review has been accomplished to certify its currency.

3.8.5 Clearance Procedure. When filing DD Form 175, Military Flight Plan (or authorized substitute), the basis

Table 3-1. Major Modification or Repair Guideline

Basic Weight (Pounds)	Weight affected by Major Mod as Percent of Basic Weight	CG Change, Fixed-Wing (%MAC or Index)	CG Change, Rotary-Wing (Inches)
0-5,000	2.0%	0.5	0.5
5,001-50,000	1.5%	0.5	0.5
> 50,00	1.0%	0.2	0.2

for weight and balance flight clearance shall be noted. For ONE TIME USE Forms F, attach the original form to the flight plan, retain a copy with the aircraft until flight termination, and retain a copy in the weight and balance handbook with the aircraft custodian/technician for 90 days upon mission completion or in accordance with command procedures. For Forms F based on standardized loadings, retain the forms in the weight and balance handbooks until superseded.

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

3.8.6.1 Computer output sheets when the data recorded is identical to that required on the DD Form 365-4.

3.8.6.2 The designated commercial type loading schedule for C-9 and C-40 aircraft.

3.8.6.3 Other Commercial loading schedules approved by the appropriate Service Engineering Organization.

3.8.6.4 Computer programs that replicate the DD Form 365-4 forms shall follow the requirements in Chapter 6, paragraph 6.2 of this Technical Manual.

3.9 AIRCRAFT WEIGHING REQUIREMENTS. Aircraft shall be weighed when any of the following conditions exist:

a. As required by pertinent service directives or technical directives.

b. In accordance with weighing requirements specified in applicable aircraft loading manual, operators manual or Chart E.

c. After completion of selected depot level events as defined by appropriate Service Engineering Organization.

NOTE

Selected depot level events include the replacement of major structural members such as spars, wings, tail booms

d. When major modifications or repairs are made:

(1) The weight and balance technician/custodian or appropriate Service Engineering Organization authority shall determine when an aircraft has undergone a “major modification or repair”. As a guideline, a major modification or repair is one that affects the Basic Weight to an extent that exceeds the thresholds as reflected in Table 3-1. (See Chapter 8 - Service Specific Requirements [Army 8.1.7a(2); Navy 8.2.8b(5); Air Force 8.3.9e; USCG 8.4]).

e. When aircraft modifications or repairs are accomplished and calculated or actual weight and moment data for the modification is not available, or reliable as determined by the Service Engineering Organization. Weight and moment changes for items affected by a modification or repair may not be known for in-service aircraft.

f. When an aircraft is completely stripped and repainted or additional layer(s) of paint is added to the entire aircraft. Consult Service Engineering Organization for guidance when aircraft are partially painted.

g. When the weight and balance data is suspected to be in error.

h. When unsatisfactory flight characteristics are reported that cannot be determined to be the result of improper aircraft loading, an error in weight and balance data, or any other identifiable cause.

i. Whenever inactive aircraft become active as described in paragraph 3.7.1.

j. When the weight and balance handbook needs replacement and sufficient data is not available to accurately reflect the aircraft’s lost or damaged weight and balance data pages, as described in paragraph 3.7.5.

CHAPTER 4
INSTRUCTIONS FOR THE USE OF WEIGHT AND BALANCE CHARTS AND FORMS

4.1 FORM RETENTION AND DISPOSITION.

4.1.1 See Chapter 8 - Service Specific Requirements for retention/disposition requirements [Army 8.1.5; Navy 8.2.5; Air Force 8.3.6; USCG 8.4].

4.2 DD FORM 365: RECORD OF WEIGHT AND BALANCE PERSONNEL OR ELECTRONIC EQUIVALENT.

4.2.1 This form is a continuous record of weight and balance personnel (civilian or military) responsible for the correctness and maintenance of an aircraft's weight and balance handbook. It lists the name, grade/rate/rank, qualifying organization, when qualified, duty station, date of initial responsibility for maintaining the weight and balance records, and date responsibility was relieved. Other qualified personnel may make entries in the weight and balance handbook if they have been designated to do so by the individual currently assigned responsibility for the handbook. The last line entry shall indicate the person who is currently responsible for maintaining the weight and balance handbook at all times.

NOTE

Qualifying Organization is the organization responsible for qualifying the weight and balance personnel.

4.3 DD FORM 365-1: CHART A – BASIC WEIGHT CHECKLIST RECORD OR ELECTRONIC EQUIVALENT.

4.3.1 There are three primary purposes of the Chart A. The first is to provide a definition of what is included in Basic Weight for a particular aircraft. The second is to provide weight and balance data for items that may be removed from or added to the Basic Weight of the aircraft. The third purpose is to facilitate the inventory process.

4.3.1.1 The Chart A consists of a list of equipment and the equipment weight, arm, and simplified moment that is installed or is approved for installation and is part of the aircraft's Basic Weight. Items that are readily removable, not necessary for flight, and identifiable are suitable Chart A items. Safety of Flight required items may be listed if their data is required to perform aircraft weighings. Items shall be listed on the Chart A as separate entries, suitably identified in order to facilitate an inventory of equipment. At a minimum, items shall be listed by Item Number, and Item Description or Subcompartment; and weight and arm shall be provided. The Item Description shall contain the Item Name and the Item Type Designator (See MIL-STD-196). For example, Radio, RT-1939A(C)/ARC-210. Item Descriptions should not contain item part numbers. Other descriptors may be used, such as capacity, to avoid ambiguity, and to facilitate identification and inventory. Subcompartment (i.e. shelf or rack) shall contain a short appropriate description of the subcompartment. For example, LEFT HAND SIDE - LOOKING OUTBOARD – SHELF WL +25.0. The Part Number/ID field should be used to provide further detailed identification of the Chart A item to help distinguish it from another. (See Chapter 8 - Service Specific Requirements [Army 8.1.2a(2); Air Force N/A; USCG 8.4]). Part Number/ID shall be verified only by daily inspection efforts. The weight and arm shall reflect the weight and arm of the individual item, not other ancillary equipment associated with the item. For example, the Chart A Item weight and arm for the Radio, RT-1939A(C)/ARC-210 shall be its weight and arm, and shall not include the Radio, RT-1939A(C)/ARC-210 mount. The Radio, RT-1939A(C)/ARC-210 mount may be another Chart A item. Table 4-1 identifies guidelines for determining suitable minimum item weight thresholds for listing items in Chart A in addition to other criteria discussed. Items that do not meet these guidelines may be listed if it facilitates the aircraft inventory process or should be accounted for during an inventory.

Table 4-1. Minimum Weight Threshold Guideline for Chart A Items

Basic Weight (pounds)	List Items In Chart A That Weigh Greater Than Or Equal To:
Less than 5,000	1 pound
5,000 to 50,000	2 pounds
Greater than 50,000	5 pounds

4.3.1.2 Alternate items shall be listed as a suffix of the primary item number. For example, if a primary item is A-015.00, but there exist several alternate items that may be installed in the same location, the alternates shall be listed as A-015.XX where XX is any value from .01 to .98 and identified as alternates to item A-015.00. Equipment which are alternates to each other shall be suitably identified, e.g., "(alternate to item A-021.XX)" or similar. If an item can be located in alternate positions (e.g. "stowed" or "installed"), the item shall be listed for both locations and so labeled.

4.3.1.3 Aircraft compartments shall be designated by capital letters and appropriate descriptive nomenclature. The compartment letter designation and name shall be shown at the top of each page in the comparment block. On DD Form 365-1 (paper) form, compartment designation shall be designated at the top of each page in the Compartment Description block. Designated limits of each compartment, in inches from the reference datum, shall be included in the Compartment Limits block. Compartment limits should agree with those shown in the aircraft loading manual. External equipment compartment(s) are exempt from designating limits of the compartment. Equipment located external to body compartments, e.g., in wings, nacelles, shall be listed at the end of Chart A under appropriate designations. Illustrations of Chart A item locations should be kept with the Chart A to facilitate the inventory process.

4.3.1.4 The order in which items are listed shall facilitate conducting the inventory. The balance arms should increase progressively from forward to aft in a compartment. If a floor or partition divides a compartment into distinct sections, the Chart A items for that compartment shall be listed by sections. No item or group of items shall be listed in a compartment unless the installed location of the item or group falls within the compartment. Items shall be numbered sequentially by compartment.

4.3.1.5 Weights, moments, and arms should be listed to one decimal place. Moments can be simplified by a constant (10; 100; 1,000; 10,000; 100,000). Constant shall be listed on each page.

4.3.2 A Chart A inventory shall be performed whenever:

4.3.2.1 The aircraft is transferred to a new custodian/ technician, the receiving activity shall inventory the aircraft to ensure the Chart A is accurate. The transferring activity may inventory the aircraft if desired or if mandated by local requirements.

4.3.2.2 As required by pertinent service directives or modifications. (See Chapter 8 - Service Specific Requirements [Army 8.1.8b; Navy 8.2.5a(2) and 8.2.9; Air Force 8.3.10; USCG 8.4]).

4.3.2.3 The pilot reports unsatisfactory flight characteristics with weight and/or balance implications.

4.3.2.4 The aircraft is weighed.

4.3.2.4.1 A header entry shall be made in DD 365- 3 Chart C providing the Date of the Inventory in the Date Column and in the Description Column enter “Calculated weight and moment per inventory completed at (inventory location).”

4.3.3 The Chart A shall be updated whenever:

4.3.3.1 The aircraft is inventoried.

4.3.3.2 The aircraft is weighed.

4.3.3.3 The aircraft is received.

4.3.3.4 As directed by a pertinent service directive or aircraft modification instruction.

4.3.3.5 As modifications or configuration changes are made to the aircraft affecting, adding, or deleting Chart A items.

4.3.4 At the time of delivery, the manufacturer inserts the designation of the aircraft’s TMS/MDS, Serial Number/BUNO, Constant, Compartment, Compartment Description, and Compartment Limits in the spaces provided at the top of the Chart A. The manufacturer marks the IN AIRCRAFT column to indicate the items of equipment in the aircraft for the delivery condition. This delivery inventory reflects the equipment status consistent with the aircraft’s initial Basic Weight and Moment as listed on the Chart C.

4.3.5 All Chart A inventories subsequent to the manufacturer’s delivery inventory shall be completed as follows:

4.3.5.1 Inspect the aircraft for equipment currently installed. Record the date and location at which the inventory was completed. If the inventory is completed for an actual weighing, the date shall match the date on the Form B. For DD 365-1, place a check in the IN AIRCRAFT column to indicate the presence of an item or a zero to indicate absence. If a partial quantity of an item is present at the time of inventory, make appropriate Chart A and Chart C entries to ensure that the Chart C Basic Weight corresponds to the configuration of the aircraft. Do not mark the item as IN AIRCRAFT unless the item is fully installed.

4.3.5.1.1 If trapped fuel is listed on the Chart A, it shall NOT be marked as IN AIRCRAFT. When applicable, trapped fuel shall be listed in COLUMN I of the Form B, as it is not part of the Basic Weight. Army - see 8.1.7f.

4.3.5.1.2 If unusable fuel is listed on the Chart A, it shall be marked as IN AIRCRAFT. If unusable fuel is not listed in the Chart A, it shall be listed in COLUMN II of the Form B, as it is included in the Basic Weight. Army 8.1.7f.

4.3.5.1.3 Adjustments to Basic Weight for the fuel condition at the time of weighing shall be made in COLUMNS I and II of the Form B.

4.3.5.2 During an inventory, note whether any new items or equipment have been installed or previous items permanently removed from the aircraft. For new Chart A items, enter an item number, the name or description (include pertinent information such as date entered and/or service directive number), weight, arm, and moment data. Chart A item numbers shall never be re-used. For permanently removed items, mark the item as not IN AIRCRAFT, and change the description to indicate that the item has been permanently removed, and why such as a service directive. Preserve alternate items if still in use. If an alternate item will be permanently installed, follow the numbering convention specified in paragraph 4.3.1.2.

4.3.5.3 Identify the location where the inventory was performed and the date of the inventory in the Record of Checking column header on DD 365-1 forms.

NOTE

When using manual DD FORM 365-1 Forms, marks in the IN AIRCRAFT and CHART C ENTRY columns are made only at the time of a complete inventory. Never change the marks or add new ones under a previously accomplished inventory.

4.3.5.4 When using DD Form 365 forms, compare this new inventory with the last completed inventory, noting any changes in the items or quantities of equipment installed in the aircraft. Refer to Chart C to ascertain whether the necessary weight and moment corrections have been made. If so, place check marks opposite such items in the CHART C ENTRY column of Chart A. If not, correct the calculated Basic Weight and moment data on Chart C, using the date of the inventory, and then enter the CHART C ENTRY column check marks. A check mark in the CHART C ENTRY column indicates the appropriate weight and moment change has been recorded on the Chart C. To assist with this procedure between inventories, when a Chart A item is added or removed from the aircraft, enter, in pencil, the date removed/installed, in the ITEM DESCRIPTION column of the Chart A. After a complete inventory, erase all existing pencil entries made in the ITEM DESCRIPTION columns.

4.3.6 The procedures for applying a replacement Chart A is as follows:

4.3.6.1 DD 365-1 Replacement Procedures: When replacing an existing DD 365-1 Chart A follow the following steps:

4.3.6.1.1 Ensure the old Chart A is correct and maintained/isolated to ensure traceability to the last weighing. After the next subsequent aircraft weighing and posting to Chart C, the old Chart A may be discarded.

4.3.6.1.2 Copy the latest inventory data, to the greatest extent possible, from the previous old Chart A into Column 1 of the new Chart A.

4.3.6.1.3 Make a header entry in Chart C specifying that a new Chart A was applied this date and Column 1 inventory data was taken from the previous Chart A.

4.4 DD FORM 365-2: FORM B - AIRCRAFT WEIGHING RECORD OR ELECTRONIC EQUIVALENT.

4.4.1 The purpose of the Form B is to record the data obtained from an actual aircraft weighing. This form also provides the necessary instructions for computing the current weight, moment and center of gravity (CG) of the aircraft.

WARNING

The Form B is the only time in which un-simplified moments are employed when the aircraft has a constant assigned.

NOTE

Instructions for weighing aircraft are in the aircraft specific manuals or in Chapter 5 (Weighing Aircraft) of this manual.

4.4.2 Use of weighing worksheets is recommended for recording measurement results when using electronic forms.

4.4.3 The following are instructions for completion of the Form B:

4.4.3.1 Fill in the Form B header information: Date Weighed, TMS/MDS, Serial Number/Bureau Number, Place Weighed, Person Responsible for Weighing, Duty Phone and Email Address of Person Responsible.

4.4.3.2 Enter the last entry from the Chart C prior to weighing: Basic Weight and Arm or %MAC.

4.4.3.3 Enter the Allowable Weighing Tolerances (See Chapter 5.5 Table 5-1) for the current Basic Weight based on the Last Entry from the Chart C. Multiply applicable tolerance by the last entry on the Chart C to determine the tolerance magnitude. Subtract the tolerance magnitude from the Last Entry on the Chart C to determine the Basic Weight (low). Add the tolerance magnitude to the Last Entry on the Chart C to determine the Basic Weight (high).

4.4.3.4 Enter the Allowable Weighing Tolerances (See Chapter 5.5 Table 5-1) for the current Arm or %MAC based on the Last Entry from the Chart C. Multiply applicable tolerance by the last entry on the Chart C to determine the tolerance magnitude. Subtract the tolerance magnitude from the Last Entry on the Chart C to determine the Arm or %MAC (low). Add the tolerance magnitude to the Last Entry on the Chart C to determine the Arm or %MAC (high).

4.4.3.5 Identify the reaction points used in the REACTION column (wheels or jack-points).

4.4.3.6 Enter the as-weighed weight data in the SCALE READING column for each reaction.

4.4.3.7 In the separate CORRECTIONS block, enter the corrections necessary for each of the reactions:

4.4.3.7.1 Calibration corrections are determined by the calibration laboratory, if applicable.

4.4.3.7.2 Scale correction factor is required when the scale does not return to zero after the load is removed from the scale. If the scale is unloaded and returns a value other than zero, the scale correction factor is that same number but of opposite sign. If the scale returns a negative value, the scale correction factor must be positive. If the scale returns a positive value, the scale correction factor must be negative.

4.4.3.7.3 Scale operating instructions will specify latitude and altitude correction factors and temperature correction factors, if applicable.

4.4.3.7.3.1 If not provided in scale operating instructions, refer to Latitude and Altitude Corrections in APPENDIX C Table C-1.

4.4.3.7.4 Equipment corrections such as chocks, blocks, slings, and jacks included in the scale reading to be subtracted from the scale reading.

4.4.3.7.5 Enter any other appropriate corrections.

4.4.3.8 Total the corrections block for each reaction and use these values in the CORRECTIONS column for each reaction.

4.4.3.9 Sum the SCALE READING and CORRECTIONS block to obtain the NET WEIGHT for each reaction.

4.4.3.10 Dimensions E and F shall be obtained and entered in both the MEASUREMENTS Section and the ARM column. When the aircraft is weighed on wing and/or fuselage jack points, dimensions E and F may be obtained from weighing instructions for the particular aircraft. When weighing the aircraft on wheels or landing gear jack points, the values of E and F shall be calculated by measuring dimensions B, D, and I. Using B, D and I, calculate and enter dimensions E and F in inches.

4.4.3.11 Multiply the NET WEIGHT of the Main Reaction SUB-TOTAL by the ARM to obtain the un- simplified MOMENT of the Main reactions.

4.4.3.12 Multiply the NET WEIGHT of NOSE or TAIL reaction(s) by the ARM to obtain the un-simplified MOMENT of the NOSE or TAIL reaction(s).

4.4.3.13 Sum the NET WEIGHT AND MOMENT columns of all eactions to determine the TOTAL (as weighed) row.

4.4.3.14 Divide the TOTAL MOMENT by the TOTAL NET WEIGHT to obtain the TOTAL ARM of the aircraft before adjustments.

4.4.3.15 In COLUMN I, record the weight and moment of all items in aircraft when weighed, but NOT part of Basic Weight.

4.4.3.16 In COLUMN II, record the weight and moment of all Basic Weight items that were not in the aircraft when weighed.

4.4.3.17 USN/USMC units - see paragraph 8.2.8 regarding COLUMN II entries on Form B.

4.4.3.18 Subtotal Columns I and II.

4.4.3.19 Add the TOTAL NET WEIGHT and MOMENT (as weighed) from the front of the Form B and the totals from COLUMN I and II to determine the BASIC AIRCRAFT NET WEIGHT and MOMENT in the provided section. This shall be posted to the Chart C.

NOTE

The term NET WEIGHT indicates an "as weighed" value, including CORRECTIONS.

4.4.3.20 In the SCALE section, fill in SCALE TYPE (make and model), SERIAL NUMBER (of all scales/load-cells used), CALIBRATION DATE, and CALIBRATED ACCURACY.

4.4.3.21 Identify REACTIONS USED (wheels or jack-points)

4.4.3.22 In the REMARKS Section, enter at a minimum: "Aircraft clean, dry, fuel system condition (dry, trapped, or full using open-port method), fuel density X.X pounds per gallon, (if fuel system is full), weighed in level or non-level condition, aircraft weighed at 0 degrees nose up attitude or x.x degrees nose up attitude, inside enclosed hangar, using jack/load-cells or platform scales. Scale Settings (if applicable): Altitude: _____ and Latitude: _____." Additional remarks may be noted.

4.4.3.23 If the weighing results are within the Weighing Tolerances, Post Basic Weight and Moment to Chart C.

4.4.3.24 Complete the actions listed in paragraph 5.5 if the weighing results are NOT within allowable tolerances.

4.4.3.25 If the weighing was performed by non-government/military personnel, and if required by the contract, include the name of the government witness, e.g. DCMA representative, in the REMARKS section.

4.5 DD FORM 365-3; CHART C – BASIC WEIGHT AND BALANCE RECORD OR ELECTRONIC EQUIVALENT.

4.5.1 The Chart C is a continuous and permanent history of the aircraft Basic Weight, moment, and CG. Any required change to the aircraft Basic Weight and/or Moment shall be recorded on the Chart C. The last line of the Chart C (aircraft Basic Weight, moment, and CG) is the most current data and the baseline for all subsequent loading calculations on Forms F.

4.5.2 Each page of the Chart C shall list the MDS/TMS and Serial Number/Bureau Number of the aircraft. The constant shall also be listed at the top of each page.

4.5.3 At the time of delivery of a new aircraft, the manufacturer enters the aircraft Basic Weight, Moment, and CG on the Chart C.

4.5.4 Changes to the Basic Weight, Moment and CG or index on the Chart C shall be accomplished as follows:

4.5.4.1 Enter the Date the action occurred

4.5.4.2 Enter the Action that occurred:

4.5.4.2.1 Header (H): No weight change occurred, used to make a note on the Chart C.

4.5.4.2.2 Addition (A): Item was added to aircraft.

4.5.4.2.3 Chart C Recertification (S): Chart C was reviewed by (enter name) at (enter location).

4.5.4.2.4 Inventory (I): Chart A inventory review was completed by (enter name) at (enter location).

4.5.4.2.5 Removal (R): Item was removed from aircraft.

4.5.4.2.6 Weighing (W): Weighing of aircraft.

4.5.4.3 Enter the item's Weight, Arm, and Simplified Moment under the "Weight Change" Columns. Units used should be designated in the Weight, Arm, and Simplified Moment blocks.

4.5.4.4 Current Total Basic Aircraft columns (Basic Weight, Simplified Moment, Arm or Index) should be updated based on addition or removal that occurred. Current %MAC shall also be noted after each action.

4.5.4.5 Whenever Basic Weight items are installed or removed from the aircraft, ensure the change is reflected on the Chart C. If the entry is for a Chart A item, ensure Chart C entry matches the data in Chart A. If the item is not a Chart A item, determine the item's weight, arm, and moment by applicable aircraft modification instructions or actual measurement. Record this data on the Chart C and if applicable add the data to the Chart A.

NOTE

For test/developmental equipment and/or temporary installations/removals, entries may be recorded on the Form F.

4.5.4.6 Subsystem modifications or structural changes and other changes that affect items not listed in Chart A shall be recorded as additions to or removals from Chart C Basic Weight and Moment. For non-Chart A items, values can be grouped and entered on the Chart C as "Structural" or "Electrical" removals and additions. Structural and Electrical changes or provisions for equipment should not be entered on Chart A.

4.5.4.7 Any change that is caused by a specific aircraft modification shall be entered in accordance with the instructions in the modification and shall reference the modification number.

NOTE

When making changes as the result of an aircraft modification instruction: Enter a header to indicate that the following changes are the result of that instruction. Enter applicable Chart A additions and removals, and Chart C additions and removals (utilizing structural and electrical summations). End the modification with a header to indicate completion.

If an aircraft modification instruction does not contain sufficient weight and balance information to properly update the weight and balance records, or the instruction for updating the weight and balance records are in error (e.g. no instruction to add/remove Chart A equipment to/ from the Chart A or incorrect instruction to add non Chart A equipment to the Chart A), notify the Service Engineering Organization.

For DD 365-3, whenever a new Master Chart A is applied, enter a Header on the Chart C briefly explaining the event.

4.5.4.8 Whenever a Chart A inventory or inspection reveals that equipment changes, subsystem modifications, or structural changes have been made to the aircraft but were not properly recorded in the Chart C, the change to Basic Weight and moment shall be posted in Chart C as required in the preceding paragraphs. The newly calculated Basic Weight, moment and arm (or index) shall be dated to agree with the inventory date entered on the Chart A.

4.5.4.9 Whenever an aircraft is weighed, the Chart C shall be updated to show the new Basic Weight, simplified moment, and arm (or index) from the Form B. The date entered on the CHART C shall agree with the inventory date entered on the Chart A and the weighing date entered on Form B. [See 8.3.9c for USAF requirement].

4.5.4.10 When the Chart C Basic Weight is changed by +/- 0.3%, or Basic CG is changed by +/- 0.3 inches, a new Form F which reflects this change must be prepared. (See Chapter 8 - Service Specific Requirements for Temporary Changes [Army 8.1.6a, Navy N/A; Air Force N/A; USCG 8.4]).

4.6 CHART E – AIRCRAFT LOADING MANUAL / WEIGHING INSTRUCTIONS.

4.6.1 The Chart E provides the aircraft specific information necessary to load and weigh the aircraft (i.e. weighing configuration, draining instructions, etc.) and weight and moment data for mission load items necessary to prepare the Form F for the aircraft (i.e. center of gravity limits and the weights and moments of all variable load items).

4.6.2 Aircraft without Chart E weighing instructions may use the general weighing instructions contained in this manual.

4.7 DD FORM 365-4: WEIGHT AND BALANCE CLEARANCE FORM F OR ELECTRONIC EQUIVALENT.

4.7.1 The Form F is the summary of the actual disposition of the load carried by the aircraft. It is the official record of the computations done by weight and balance personnel to ensure the weight and CG limits are not exceeded at takeoff, during flight, and at landing due to loading conditions. Weight and moment data necessary for completion of Form F are found in Chart E.

WARNING

All moments on the Form F are simplified moments unless the aircraft does not use a moment simplifier.

NOTE

It is acceptable for weight and moment values on Form F to be expressed as whole numbers. Electronic equivalent forms may use added precision if the system enables it.

4.7.1.1 After completion, the Form F shall be filed in accordance with local procedures or applicable service instructions.

4.7.1.2 Basic Weight items should not be entered on Form F. If Basic Weight items are entered on Form F, extreme care must be taken to ensure that the weight and moment of these items are not duplicated by being reflected in Chart C Basic Weight and Moment. Further, when using a Form F for multiple Serial Numbers/BuNos (Standardized Loading Form F), extreme care must be taken to ensure double accounting of Basic Weight items entered on the Form F does not occur.

4.7.2 FORM F. The following instructions illustrate the use of CHART E data for completion of the FORM F. If a load adjuster is used in lieu of the Chart E, enter the load adjuster plate number in the REMARKS block and use index values in lieu of moments throughout the form. For simplicity, the following instructions refer to entering weight and moment (simplified) data; however, index values are entered and summed in the same manner. See Chapter 6 (Weight and Balance Tools) for instructions regarding the use of a load adjuster in completing a Form F.

4.7.2.1 Enter the necessary identifying information at the top of the form.

4.7.2.1.1 DATE: Enter the date the Form F was created, or the date it was last recertified.

4.7.2.1.2 MISSION: Enter the name of the mission.

4.7.2.1.3 MDS OR TMS: Enter the MDS/TMS of the aircraft.

4.7.2.1.4 SERIAL NO or BuNo: Enter the aircraft's Serial Number or BUNO as applicable.

4.7.2.1.5 FROM: Enter the departure site. This may also be expressed as the International Civil Aviation Organization (ICAO) airfield identifier.

4.7.2.1.6 TO: Enter the arrival landing site. This may also be expressed as the ICAO.

4.7.2.1.7 PILOT: Enter the Pilot's name/rank for One Time Use forms. Enter "As Assigned" for standardized forms.

4.7.2.2 REF 1. BASIC AIRCRAFT: Enter the aircraft Basic Weight and simplifi ed moment (or index) obtained from the last entry on the Chart C.

4.7.2.3 REF 2. REF 2 is no longer used. It was for OIL. If an aircraft requires an OIL line item, then account for it under REF 3.

4.7.2.4 REF 3. OPERATING ITEMS + NON-EXPENDABLE PAYLOAD: Enter all operating items and non-expendable payload items not in the Basic Weight (e.g. crew, cargo, fuel as cargo, pylons, racks, ballast, passengers/troops, passenger/troop seats, fi xed guns, retained portion of ammunition, emergency equipment, retained external fuel tanks, etc.). Ensure any compartment weight limits are not exceeded. There are 12 available lines for REF 3 on the paper Form F. If additional rows are needed, then use the REF 3 Overflow Table on Page 3. Sum the REF 3 Overflow on Page 3 and transfer to Page 1 "REF 3 Overflow" line.

NOTE

NON-EXPENDABLE means any payload that is retained throughout the mission from take- off to landing.

NOTE

There may be two separate weight and moment entries for ammunition; one for the portion that leaves the aircraft when it is fired and one for the portion that is retained in the aircraft after firing. The weight and moment of ammunition that departs the aircraft is entered as an expendable item. The weight and moment of ammunition that is retained is entered as a non- expendable item.

4.7.2.5 REF 4. OPERATING CONDITION. Enter the sum of the weight and simplified moments of REF 1 through REF 3.

NOTE

The definition of the OPERATING CONDITION changed from the 2019 to the 2023 version of this Technical Manual due to the use of the OPERATING CONDITION as the basis for the MOST FWD and MOST AFT CG CONDITIONS.

4.7.2.6 REF 5 is no longer used. It was EXPENDABLE AMMO. Account for EXPENDABLE AMMO under REF 6.

4.7.2.7 REF 6. EXPENDABLE PAYLOAD ITEMS. Enter the item description, weight and simplified moment of all items that are planned to be expended (released from the aircraft) during flight. Examples include but are not limited to bombs, torpedoes, missiles, expendable ammo, countermeasures, rockets, paratroops, air-drop cargo, and expendable suspension and release equipment. If external auxiliary fuel tanks are planned to be released during the mission, include them here. There are 12 available lines for REF 6 on the paper Form F. If additional rows are needed, then use the REF 3 Overflow Table on Page 3. Sum the REF 6 Overflow on Page 3 and transfer to Page 1 "REF 6 Overflow" line.

4.7.2.8 REF 7. ZERO FUEL CONDITION. Enter the sum the weight and simplified moments of REFs 4 through 6. Calculate the ZERO FUEL CONDITION CG by using the following equation:

ZERO FUEL CONDITION CG (IN) = ZERO FUEL SIMPLIFIED MOMENT ÷ ZERO FUEL WEIGHT x MOMENT SIMPLIFIER

(Convert to %MAC, if necessary.)

NOTE

If there are no Expendable Payload Items, then OPERATING CONDITION will equal the ZERO FUEL CONDITION

4.7.2.9 REF 8. USABLE FUEL. Enter the weight, and simplified moment of the fuel on board at takeoff. Separate the total fuel as Internal, External and Auxiliary as appropriate. List under REMARKS the fuel tanks affected and the amount of fuel in each tank (as required). Also list the type and density of fuel.

4.7.2.9.1 The weight of fuel used during warm up and/or taxi shall not be included in TAKEOFF FUEL (REF 15).

4.7.2.10 REF 9. MISC. VARIABLES. Enter the item descriptions, weights, and moments of miscellaneous items.

4.7.211 REF 10. RAMP CONDITION. Calculate, and enter the Ramp Weight (after fueling and prior to taxi), and simplified moment by summing the weights and simplified moments of REF 7 through REF 9.

4.7.2.12 REF 11. RAMP CG. Calculate and enter the RAMP CG at the RAMP CONDITION (REF 10) per the formula below:

RAMP CONDITION CG (IN) = RAMP SIMPLIFIED MOMENT ÷ RAMP WEIGHT x MOMENT SIMPLIFIER

(Convert to %MAC, if necessary.)

4.7.2.13 REF 12. TAKEOFF CORRECTIONS. REF 12 accounts for any differences between the RAMP CONDITION and the TAKEOFF CONDITION. Examples are taxi fuel, and alcohol-water injection fluid. On the left side of the Form F in the TAKEOFF CORRECTIONS table, enter a brief description of each correction and its weight and moment listed in the columns provided. Sum the weights and simplified moments of the corrections in the TOTAL line. Transfer the REF 12 TAKEOFF CORRECTIONS on the right side of the Form F.

4.7.2.13.1 If a load adjuster is used, the revised index for each correction item, rather than plus or minus index changes shall be entered, and the RAMP index (REF 11) should be used as a starting point for all corrections.

4.7.2.14 REF 13. TAKEOFF CONDITION. Calculate and enter the Takeoff Weight and simplified moment by summing the weights and simplified moments of the RAMP CONDITION (REF 10) and the TAKEOFF CORRECTIONS (REF 12).

4.7.2.15 REF 14. TAKEOFF CG. Calculate and enter the TAKEOFF CG using the weight and simplified moment at the TAKEOFF CONDITION (REF 13) per the formula below:

TAKEOFF CONDITION CG (IN) = TAKEOFF SIMPLIFIED MOMENT ÷ TAKEOFF WEIGHT x MOMENT SIMPLIFIER

(Convert to %MAC, if necessary.)

4.7.2.16 REF 15. TAKEOFF FUEL and LESS EXPENDABLES.

4.7.2.16.1 Sum the takeoff fuel weights and simplified moments from REF 8 and enter the total weight and moment for TAKEOFF FUEL (REF 15).

4.7.2.16.2 Sum the weights and simplified moments of expendable items (See REF 6) such as expendable ammunition (not including the weight of cases and links if retained), bombs, rockets, torpedoes, and external fuel tanks that are planned to be dropped during flight and enter the subtotals under LESS EXPENDABLES. Explain under REMARKS, if necessary. There are 12 available lines for LESS EXPENDABLES on the paper Form F. If additional rows are needed, then use the LESS EXPENDABLES Overflow Table on Page 3. Sum the LESS EXPENABLES Overflow on Page 3 and transfer to Page 1 “LESS EXPENDABLES Overflow” line.

4.7.2.17 REF 16. ESTIMATED LANDING FUEL. Enter the estimated landing fuel weight and simplified moment.

4.7.2.18 REF 17. ESTIMATED LANDING CONDITION. Calculate the Estimated Landing Weight and simplified moment by subtracting the weight and simplified moment for expendables and the weight and moment of TAKEOFF FUEL (REF 154 from the weight and simplified moment at the TAKEOFF CONDITION (REF 13), and then adding the weight and moment from the ESTIMATED LANDING CONDITION (REF 15), respectively.

4.7.2.19 REF 18. ESTIMATED LANDING CG. Calculate, and enter the Estimated Landing CG using the weight

and simplified moment at the ESTIMATED LANDING CONDITION (REF 17) per the formula below:

ESTIMATED LANDING CONDITION CG (IN) = ESTIMATED LANDING SIMPLIFIED MOMENT ÷ ESTIMATED LANDING WEIGHT x MOMENT SIMPLIFIER

(Convert to %MAC, if necessary.)

4.7.2.20 LIMITATIONS. Enter the gross weight limits, e.g. TAKEOFF, LANDING, etc., from the latest applicable requirements document, e.g., Flight Manual, or Chart E, in the appropriate WEIGHT blocks of the LIMITATIONS table. Transfer the RAMP Weight (REF 10), TAKEOFF Weight (REF 13), LANDING Weight (REF 17), and ZERO FUEL Weight (REF 7) to the ACTUAL WEIGHT fields in the LIMITATIONS table. Enter the most forward and most Aft CG Limits in % M.A.C or inches that align with the ACTUAL WEIGHTS above, from the latest applicable requirements document, in the appropriate FWD LIMIT and AFT LIMIT blocks of the LIMITATIONS table.

4.7.2.20.1 Not all aircraft utilize all of the LIMITATIONS delineated on the Form F. Only perform ACTUAL Weight or CG checks against the limits required per the latest requirements document.

4.7.2.20.2 Ensure the proper limits are utilized for the mission being flown as some aircraft have different limits when operating from land or aboard ship. Sometimes basing can change. For example, an aircraft can take off from land and land aboard ship – use the appropriate LIMITS for each CONDITION.

4.7.2.20.3 Ensure that at each CONDITION the Form F loading is within limits. If any of the Weight or CG conditions are not met, i.e., the aircraft is out of limits, additional changes in the amount or location of operating items, payload (non-expendable or expendable), or fuel are required, and a new Form F shall be completed.

4.7.2.21 MOST FORWARD & MOST AFT CG CALCULATIONS. In the blocks provided in the Form F, calculate the most forward and aft CG, unless the aircraft actively controls CG during flight. The Chart E may indicate which loading conditions lead to the most forward and aft conditions during flight. Check the CG Limitations tables of the applicable Chart E, to ensure that the most forward and most aft CG are within the CG limits for flight.

4.7.2.22 On Page 2 of the Form F perform the following:

4.7.2.22.1.1 Transfer the OPERATING CONDITION (REF 4) Weight and simplified moment to the corresponding blocks on Page 2 of the Form F. Calculate the OPERATING CG via the following formula:

OPERATING CG (IN) = OPERATING SIMPLIFIED MOMENT ÷ OPERATING WEIGHT x SIMPLIFIED MOMENT FACTOR

4.7.2.22.2 In the FOR MOST FWD CALCULATION Table on Page 2 of the Form F list the expendables which have an arm forward of the OPERATING CG. Sum the weights and simplified moments and transfer these sums to the MOST FWD CALCULATION table on Page 1of the Form F.

4.7.2.22.3 On page 1 of the Form F, sum the MOST FWD CALCULATION weights and simplified moments. Calculate the MOST FWD CG (IN) using the formula below:

MOST FWD CG (IN) = MOST FWD SIMPLIFIED MOMENT ÷ MOST FWD WEIGHT x MOMENT SIMPLIFIER

(Convert to %MAC, if necessary.)

4.7.2.22.4 In the FOR MOST AFT CALCULATION Table on page 2 of the Form F list the expendables which have an arm aft of the OPERATING CG. Sum the weights and simplified moments and transfer these sums to the MOST AFT CALCULATION table on page 1 of the Form F.

4.7.2.22.5 On page 1of the Form F, sum the MOST AFT CALCULATION weights and simplified moments. Calculate the MOST AFT CG (IN) using the formula below:

MOST AFT CG (IN) = MOST AFT SIMPLIFIED MOMENT ÷ MOST AFT WEIGHT x MOMENT SIMPLIFIER

(Convert to %MAC, if necessary.)

4.7.2.22.6 Transfer the MOST FWD and MOST AFT CONDITION CGs to the ACTUAL MOST FWD CG and MOST AFT CG in the LIMITATIONS section. Compare the ACTUAL MOST FWD and MOST AFT CONDITION CGs to FWD and AFT CG limits that align with the MOST FWD or AFT CONDITION weights, respectively.

AWBS 11.x follows the above MOST FWD and MOST AFT procedure. AWBS 10 follows a different algorithm, but produces the same MOST FWD and MOST AFT CG results. Refer to AWBS 10 training for the MOST FWD and MOST AFT calculation procedures.

4.7.2.22.7 If either of the MOST FWD or MOST AFT CG conditions are not met, i.e., the aircraft is out of limits, additional changes in the amount or location of operating items, payload (non-expendable or expendable), or fuel are required, and a new Form F shall be completed.

4.7.2.23 Remarks Block. Enter pertinent information regarding mission-loading, takeoff, and/or landing conditions, as needed. Enter significant information that aircraft operators need to be aware of.

4.7.2.24 The following signatures are required as noted below. (Refer to Chapter 8 - Service Specific Requirements for signatures [Army 8.1.6; Navy 8.2.7d; Air Force N/A; USCG 8.4]):

4.7.2.24.1 COMPUTED BY. The name and signature of the assigned Weight and Balance personnel or qualified aircrew member who computed the form.

4.7.2.24.2 Weight and Balance Authority. The name and signature of the Weight and Balance Officer, Technician, Custodian, Authority, or qualified aircrew member.

4.7.2.24.3 Pilot. The name and signature of the pilot shall appear on the ONE TIME USE Forms F submitted by the pilot or another crew member for flight clearance.

NOTE

The purpose of the pilot name is to indicate the Form F has been checked for currency and accuracy. In case of Forms F based on standardized loadings, the appropriate Form F reference on the DD Form 175 (Miliatary Flight Plan).

CHAPTER 5
Weighing Aircraft

5.1 GENERAL. Aircraft weighings are required as outlined in Chapter 3, paragraph 3.9. Weighing with calibrated scales is the only sure method of obtaining an accurate Basic Weight and center of gravity (CG) location of an aircraft. Unless specified differently or in more detail in aircraft weighing instructions, the aircraft shall be in a "ready-for- flight" configuration with components required for flight installed (e.g. engines, blades), closed systems serviced to proper operating levels (e.g. hydraulics, transmission), and doors and windows closed.

5.2 WEIGHING EQUIPMENT. Aircraft weighing equipment shall be used to weigh aircraft only. Described below are three general types of aircraft weighing equipment.

5.2.1 Stationary Pit-Type Platform Scales. These scales are commonly flush floor installations, although some are used as surface-type portable scales. The flush floor installations generally are in a permanent location.

5.2.2 Portable Platform Aircraft Scales. This system consists of three or more platform scales with detachable ramps and wheel stops. Each platform is independent. Platforms can be arranged in various combinations to provide for weighing aircraft of any size and landing gear configuration. The aircraft is positioned on the platform scales and the resulting weight forces are measured. Display of the measured value is either at each platform or is transmitted to a central display that collects values from all platforms connected to it. When values are collected at the central display, ensure that the values correspond with the location on the aircraft correctly (see Figure 5-1).

5.2.3 Electronic Weighing Kit. An electronic weighing kit (see Figure 5-2) contains load cells that measure one directional force applied to them. These load cells are inserted between aircraft jacks and jack points on the aircraft for weighing aircraft. Many kits have adapters so that the load cell will fit properly to the various types of jacks. The load cell shall be placed squarely and symmetrically on top of the jack head. Aircraft jack locations require constant monitoring to ensure that the jack is in a vertical alignment with the aircraft jack point, both longitudinally and laterally, in order to avoid injury to personnel, damage to aircraft or equipment, and to ensure accurate weighing results. Some weighing kits also come with two jack pad adapters, the use of which depends upon the shape of the jack. When the aircraft is raised using the jacks and is leveled, forces are measured by the load cells and transmitted electronically to a control panel. Care must be taken to ensure each measurement is attributed to the location on the aircraft correctly. Color-coding of cables and load cells is strongly recommended to help ensure that this happens. (See Figure 5-3).

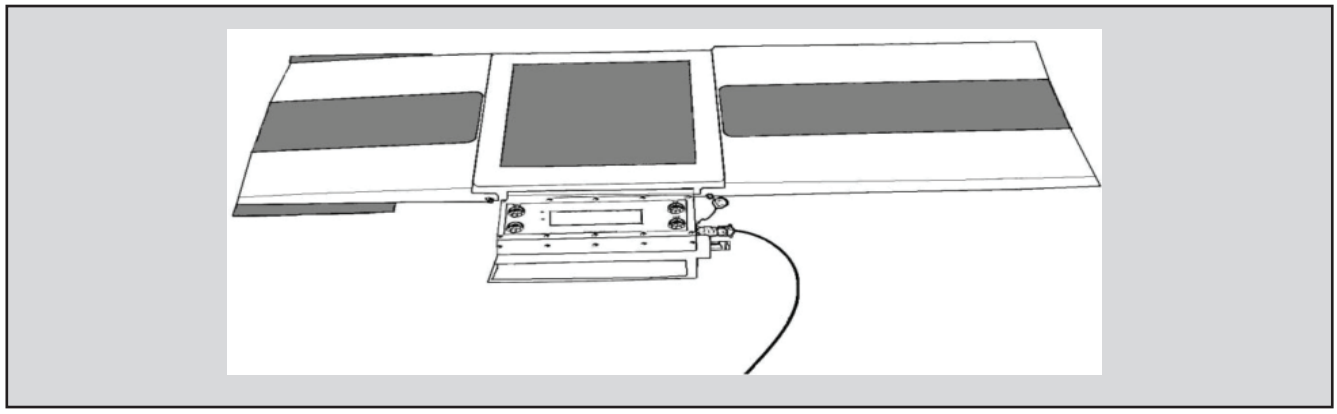


Figure 5-1. Typical Platform Scale Assembly

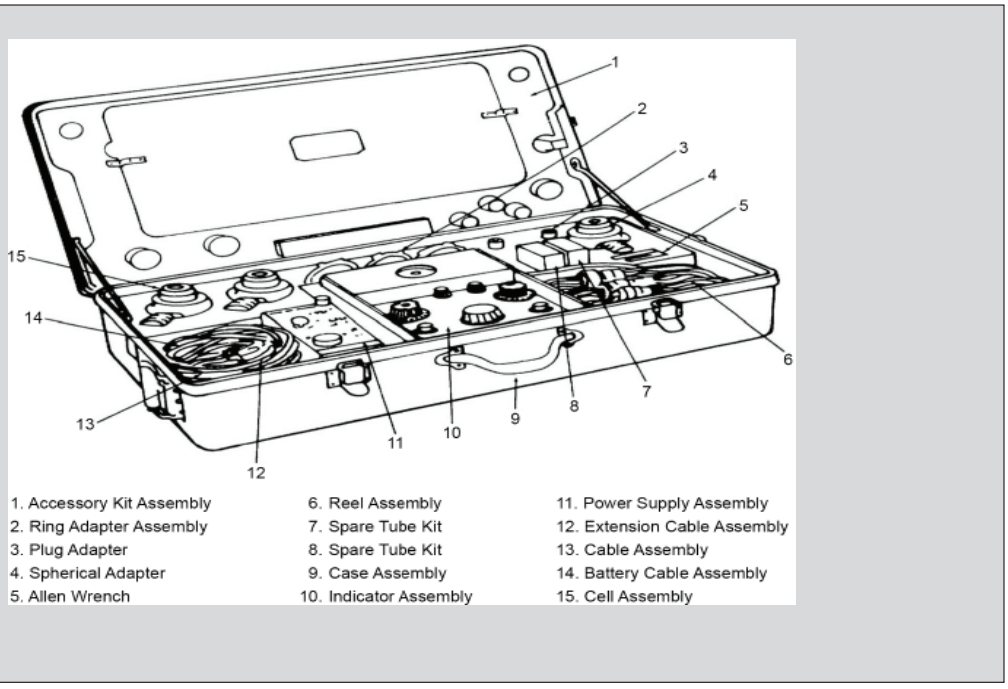


Figure 5-2. Electronic Weighing Kit (Typical)

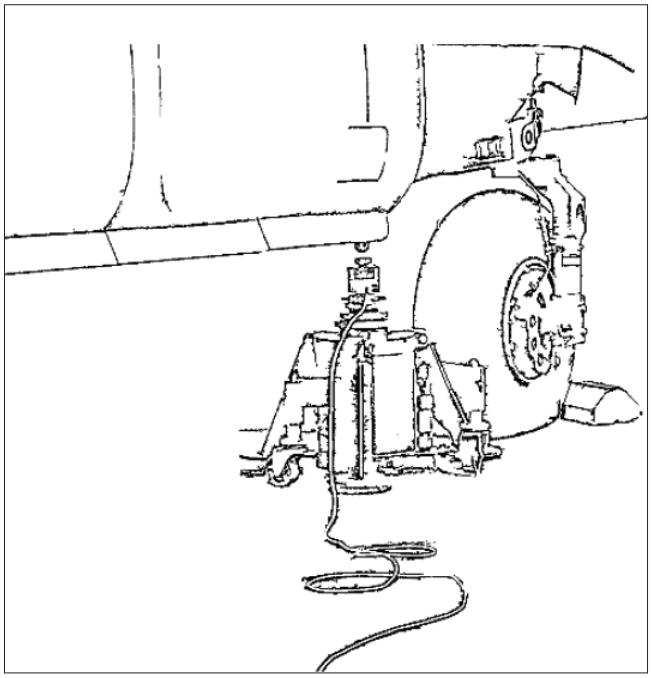


Figure 5-3. Load Cell and Jack

NOTE

Strict adherence to instructions for weighing equipment is necessary to ensure accurate results.

Refer to Chapter 8 - Service Specific Requirements for restrictions on the use of certain types of weighing equipment [Army 8.1.9; Navy 8.2.10; Air Force N/A; USCG 8.4].

5.2.4 Calibration of Weighing Equipment. All custodians responsible for and technicians using weighing equipment are responsible for having equipment calibrated and certified by a government inspector of weights and measures or by commercial scale officials. Calibration shall be traceable to the National Institutes of Standard and Technology (NIST). Calibration procedures shall be those provided by the scale manufacturer or applicable service directives.

5.2.4.1 Scale and Load Cell Calibration. Standard calibration for aircraft scales and load cells is an accuracy of +/- 0.1% of the applied load unless otherwise determined by appropriate Service Engineering Organizations (see Chapter 8 for Service-specific Requirements [Army 8.1.9; Navy N/A; Air Force 8.3.11; USCG 8.4]).

5.2.4.2 Inclinometer Calibration. Inclinometers and digital protractors must be calibrated in accordance with manufacturer's instructions.

5.3 WEIGHING ACCESSORIES. To measure data such as lengths, angles, and densities, weight and balance personnel require accessories such as levels, plumb bobs, measuring tapes, chalk lines and hydrometers. It may be necessary to prepare special devices for specific TMS/MDS that will be identifi ed in the aircraft Chart E.

5.3.1 Level. At least one level is required for leveling most aircraft. The level shall be of sufficient length to span the leveling lugs, if a leveling bar is not used. . An inclinometer or digital protractor may be used in lieu of a level.

5.3.2 Leveling Bars. Several leveling bars of varying lengths may be needed for spanning distances between leveling lugs of diff erent aircraft. One set of bars usually comes with the weighing kit normally maintained by each authorized weighing facility. Some aircraft require special bars that will be identified in the aircraft weighing instructions.

5.3.3 Leveling Lugs. Precisely located points on an aircraft to facilitate use of a level.

5.3.4 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. Plumb bobs are normally included in the weighing kit.

5.3.5 Measuring Tapes. A measuring tape of appropriate length for the aircraft weighed, and graduated in inches and tenths of inches is required. Since all weighing dimensions shall be read to one tenth of an inch, this type of tape eliminates the nuisance and the possibility of errors associated with converting common fractions to decimals. A measuring tape, as described, must be included in the weighing kit.

5.3.6 Chalk Line. This is a string, covered with chalk, which is used to snap a straight line on the hangar floor between the vertical projections of reaction points or jig locations. The string should be sturdy and hard finished. The weighing kit usually includes a chalk line reel.

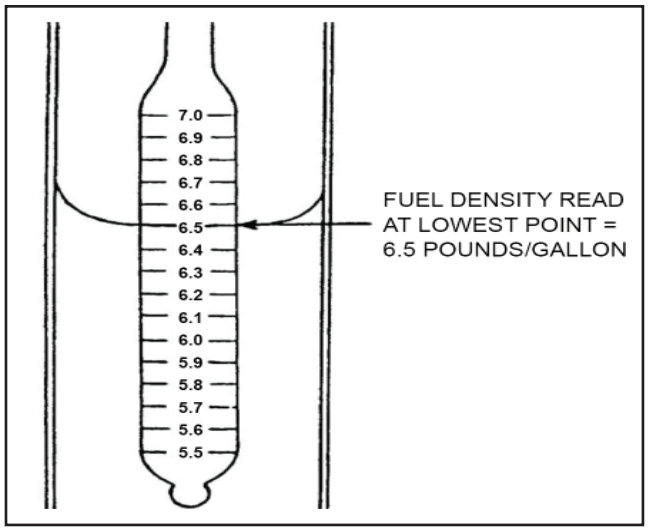


Figure 5-4 Reading a Hydrometer

5.3.7 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 and a pipette at least 12 inches long or some other similar device for withdrawing samples from the tank are necessary for use with the hydrometer. Care shall 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 shall not touch the container and the reading should be taken at the lowest fuel point (See Figure 5-4).

5.3.8 Clinometer or Inclinometer. An instrument used to measure the angle of incline or the attitude of the aircraft relative to the horizontal (level ground) is needed for those aircraft weighed in a non-level attitude. Angles shall be measured at locations specified in Chart E.

5.3.9 Thermometer. A thermometer calibrated in degrees Fahrenheit used to measure the temperature of the weighing site for scale calibration purposes. This item is not needed for scales with built-in temperature calibration.

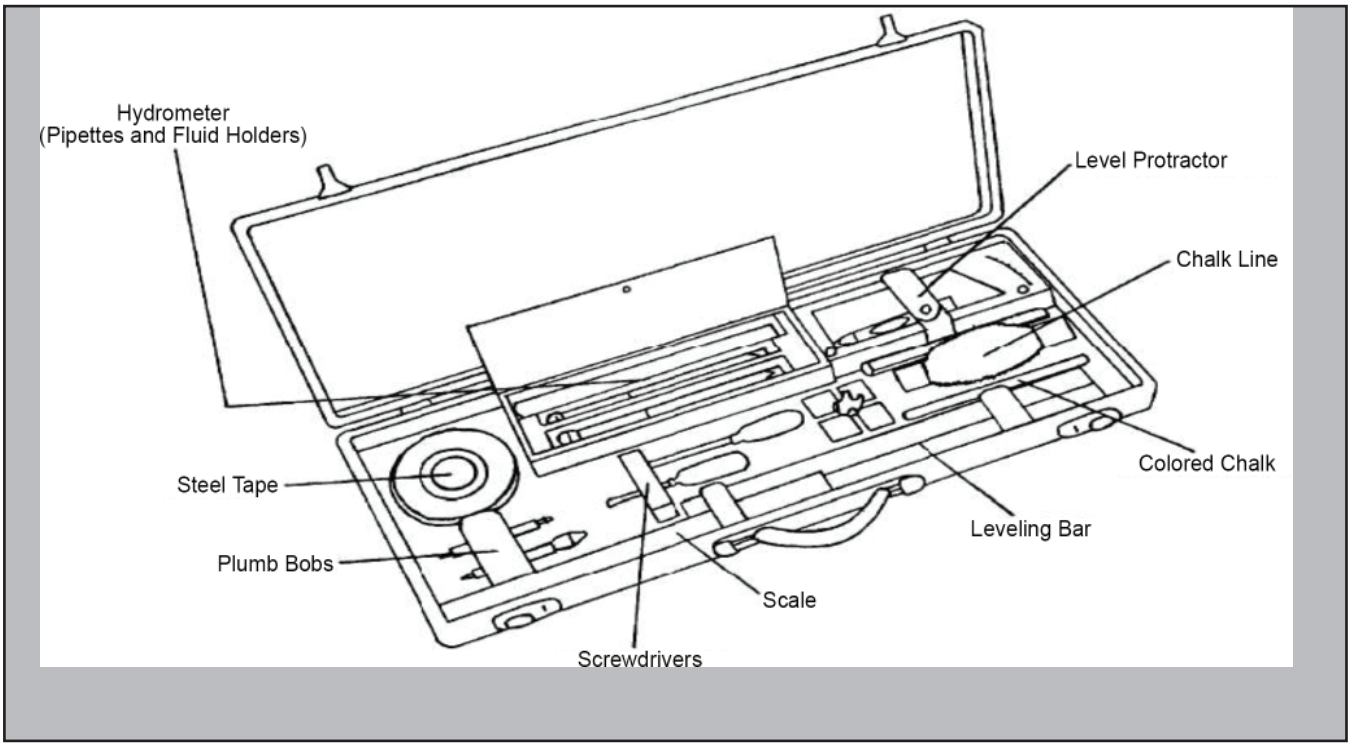


Figure 5-5. Accessory Weighing Kit

5.3.10 Accessory Weighing Kit. A kit containing compartments for each weighing accessory should be provided for storing and carrying the accessories (see Figure 5-5). This is a necessary precaution against loss or damage.

5.3.11 Aircraft Jacks. An approved type of jack may be required to raise the aircraft to a level position clear of the hangar floor. A good quality standard jack, with suitable capacity and extension range, should be used. The jack shall have an ample flat base area and have a suitable head, or adapter, to retain load cells and thus prevent slippage and resulting damage to the aircraft. The capacity of the jack points should also be checked to ensure the points would not be overloaded while weighing aircraft.

5.3.12 Jack Pad Adapters. A cylindrical-type adapter used to mate jack pads to a load cell assembly.

5.3.13 Jack Pads. Fittings attached to the aircraft structures which are used for reaction or jack points. A rounded or conical extension protrudes from the base of the jack pad and serves as the point of contact for the load cell assembly or aircraft jack.

5.4 WEIGHING PROCEDURES. A well-documented and orderly aircraft weighing procedure enables the ability to collect accurately measured weight and moment data in an efficient manner. It also lessens the chance of omitting steps necessary to collect required dimensions or scale readings. Refer to specific weighing instructions and/or procedures for specific aircraft type/design but a generic weighing flowchart is reflected in Figure 5-6. The following is a general procedure to accomplish proper aircraft weighings if specific type/design procedures are not available:

NOTE

All resulting weight and balance data is suspect to be inaccurate if proper weighing procedures are not accurately performed during the weighing.

5.4.1 Prepare the Aircraft for Weighing. The following describes the procedure to prepare an aircraft for weighing.

a. Thoroughly clean the aircraft inside and out, removing dirt and grease. It is not necessary to wash the aircraft. If the aircraft is wet or moist from rain, dew or washing, the surfaces shall be allowed to completely dry before weighing.

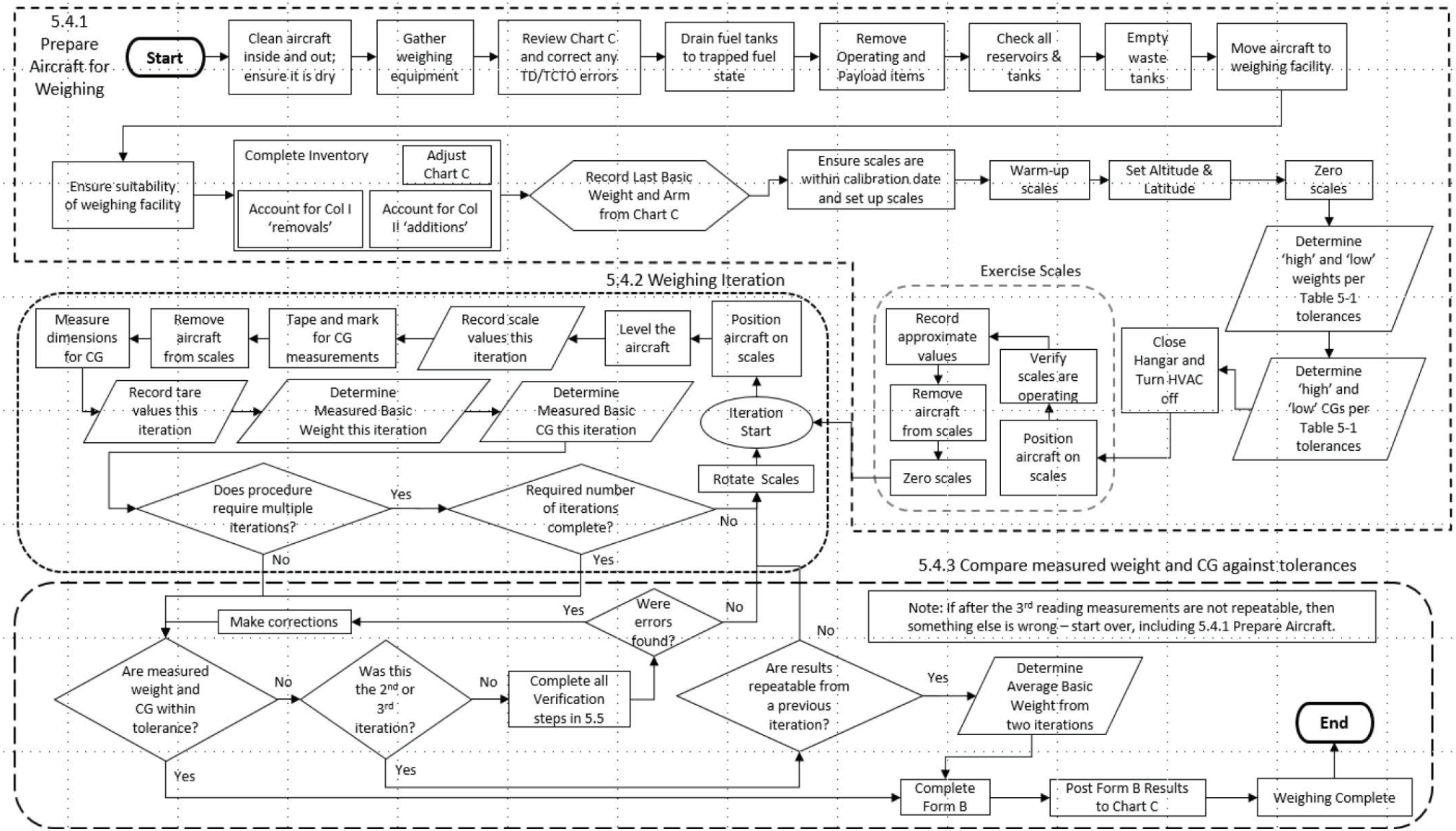


Figure 5-6. Generic Weighing Flowchart

CAUTION

Inspect areas for trapped water; drain and dry them as warranted.

b. Gather the required weighing equipment and ensure that all equipment is functional and in proper working order.

c. Review the Chart C for errors. If errors are encountered, such as a missing TD/TCTO/MWO, then fix the errors.

d. Drain the fuel tanks to a trapped fuel state in accordance with the aircraft weighing instruction or other applicable instructions. If not otherwise specified in the aircraft weighing instruction, drain the aircraft in level ground attitude.

NOTE

It is important that the fuel in the aircraft at the time of weighing duplicates the condition that has been established by the manufacturer's testing, which corresponds to the trapped fuel data provided in the aircraft weighing instruction.

Aircraft with foam in their tanks pose special problems. Aircraft with foam in the wings require tanks filled to capacity and then drained to a trapped fuel condition in order to duplicate the trapped fuel values. These aircraft always retain fuel in the foam; therefore, unless specific instructions are in the aircraft Chart E, draining should be terminated when the flow is clearly discontinuous.

e. Operating Items and Payload items, i.e. Chart E items, should not be in the aircraft when it is weighed. These types of items are not listed as part of the Basic Weight on the Chart A and, therefore, should not be in the aircraft when it is weighed.

f. Check all reservoirs and tanks for liquids such as drinking and washing water, engine oil, hydraulic fluid, anti-icing fluid, cooling fluids, and liquid oxygen. Reservoirs and tanks should be empty or filled to normal capacity prior to weighing. Never weigh aircraft with partially filled reservoirs or tanks.

g. All waste tanks shall be empty.

h. Move the aircraft to the weighing facility. Ensure aircraft control surfaces are in a static neutral position and that all doors, canopies, rotor blades, folding wings/ pylons, etc. are positioned in accordance with the Chart E. Inflate tires to normal pressure.

NOTE

Depending on the situation, a brake rider may be required to safely weigh and/or move an aircraft. Ensure that the brake rider does not apply the brakes at any time other than an emergency.

i. The aircraft shall be weighed in a closed hangar, or building, with all ventilation systems off. The slope of the floor shall not exceed 1/4 inch in one foot (1.2 degrees). Do not place scales on or over a crack or drain in the floor. Jacks may straddle engineered expansion joints providing elevation does not change.

NOTE

Civil Engineering, Public Works, or Facilities is responsible for ensuring compliance with the floor slope requirement. It is the responsibility of the weighing unit to verify that compliance is documented.

j. Conduct a Chart A inventory of equipment installed in the aircraft. This inventory shall be done by qualified Weight and Balance personnel sufficiently knowledgeable and experienced with the aircraft.

NOTE

A Basic Weight determined via weighing the aircraft without the associated inventory is of no value.

(1) Check the aircraft equipment against the Chart A and make corrections as necessary to accurately itemize all items of fixed operating equipment that will be included in the Basic Weight determined by weighing. The aircraft Chart A 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.

(2) Based upon the Chart A inventory, adjust the Chart C, if necessary, and complete the inventory. Account for Column I removals and Column II additions on the Form B.

k. Record the results of the inventory on the Form B in the "Prior to Weighing Last Entry on Chart C" weight and CG blocks.

l. Ensure all the scales are within their calibration date. If the scales are portable, set up the scales in accordance with the scale manual. Ensure battery operated scales are fully charged, or are plugged in.

CAUTION

Equipment damage may result from improper connection to power sources. Consult manufacturer's instructions for proper use of power sources. Do not connect external power if non-rechargeable batteries are installed.

m. Warm up the scales.

n. Adjust scales for current location's altitude and latitude, if they are capable. If they are not, record manual adjustments in the LATITUDE/ALTITUDE CORRECTIONS block of the Form B. (See Appendix).

NOTE

Failure to adjust the scales for latitude and altitude will result in erroneous scale readings. Corrections for altitude and latitude shall be made in the scale settings or in the corrections block – not both.

o. Zero the scales

p. Determine the Allowable Weighing Tolerances per Table 5-1. Record these weight and Arm/% MAC values on the Form B in the appropriate blocks.

q. Close the hangar doors and turn off the HVAC system. Air flowing over aerodynamic surfaces, such as wings and rotor blades, or impinging on the aircraft outer mold line will impart forces on the aircraft, and lead to erroneous scale readings.

r. Exercise the scales

(1) Position the aircraft on the scales.

(a) Platforms. Do not use the aircraft brakes to stop the aircraft, because they may bind the scales and this would require re- zeroing of the scales. Ensure that the nose wheel (or tail wheel) is centered. Do not set the aircraft brakes because this may induce errors into the weighing, and may damage the scales.

(b) Load Cell on Top of Jack. Position the aircraft jacks with the load cell installed directly under the jack fittings. Ensure that the jacks and load cells are vertical by checking with a level or with the inclinometer and ensure that the jack/load cell combination is directly under the jack fitting on the aircraft both fore/aft and left/right.

(2) Verify that the scales are operating properly.

(3) Record the approximate scale values.

NOTE

These values will not be used in calculation but are recommended as a check for the actual weigh.

(4) Remove the aircraft from the scales.

(5) Zero the scales.

5.4.2 Weighing Iteration. The following describes the procedure to successfully complete one weighing iteration.

a. Position the aircraft onto the scales.

(1) Platforms. Do not use the aircraft brakes to stop the aircraft, because they may bind the scales and this would require re-zeroing of the scales. Ensure that the nose wheel (or tail wheel) is centered. Do not set the aircraft brakes because this may induce errors into the weighing, or may damage the scales. If necessary, put chocks in place but ensure that they are not in contact with tires.

(2) Load Cell on Top of Jack. Position the aircraft jacks with the load cell installed directly under the jack fittings. Ensure that the jacks and load cells are vertical by checking with a level or with the inclinometer and ensure that the jack/load cell combination is directly under the jack fitting on the aircraft both fore/aft and left/right.

b. Level the Aircraft. For most aircraft all weight and balance computations are based on measurements taken when the aircraft is in a level position. This position is achieved when the longitudinal and lateral axes of the aircraft are in a horizontal plane. Leveling aids have been installed in the aircraft by the manufacturer, and procedures have been developed to enable the aircraft to be positioned in a level attitude. Some aircraft use spirit levels to position the aircraft while other aircraft use plumb bobs in combination with leveling plates. See the Chart E for the particular aircraft being weighed for proper method and procedure.

Table 5-1 Weighing Tolerances

Aircraft Basic Weight	Weight Tolerance (pounds)	Arm Tolerance	
		%MAC	ARM
≤ 75000 pounds	± Basic Weight x 0.4%	± 0.2%	± 0.2 inches
> 75000 pounds	± Basic Weight x 0.5%	± 0.5%	± 0.5 inches

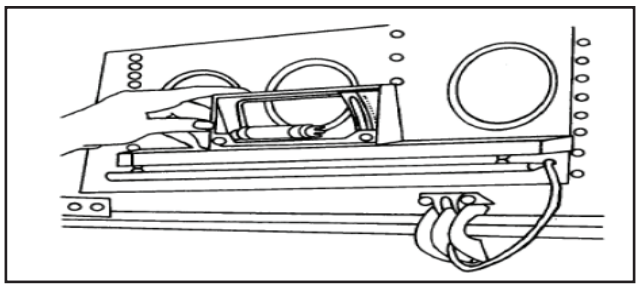


Figure 5-7 Leveling Lugs Inside the Aircraft

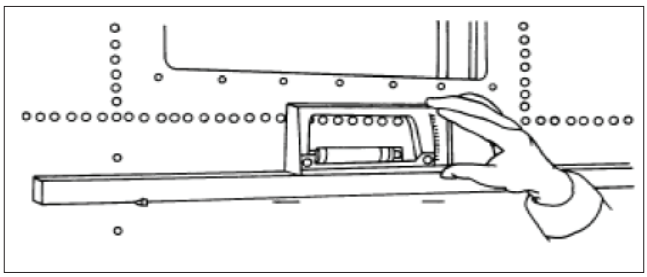


Figure 5-8 Leveling Lugs Outside the Aircraft

NOTE

Some aircraft are weighed in a static, non-level position. Specific type/design weighing procedures contain instructions to correct for aircraft weighed in a non-level attitude. In this procedure, the angle the aircraft longitudinal axis makes to the horizontal plane is measured by either placing an inclinometer on the leveling bar or using a leveling plate provided in the aircraft by the manufacturer. See Chart E instructions.

(1) Levels, Inclinometer or Digital Protractor. Leveling lugs may be located on the inside or outside of the aircraft (see Figures 5-7 and 5-8). When the lugs are located inside the aircraft, it is often necessary for personnel observing the level to remain in the aircraft while it is being weighed to avoid disturbing its equilibrium. In this case, the weight and moment of the observer shall be subtracted from the total weight and moment by entering values in Column I of the Form B. To use the leveling lugs, place the leveling bar squarely on the lugs. Then place the leveling device on the leveling bar. The aircraft shall be leveled both longitudinally and laterally.

(2) Plumb Bob. Another device provided for leveling of aircraft is a plumb bob (see Figure 5-9). 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 the upper jig-located bracket and adjust the length of the string to allow the plumb bob to swing very close to, but not touch, a graduated leveling plate. When the plumb bob is allowed to come to rest from swinging, the position of the plumb bob relative to the leveling plate indicates whether the aircraft is level or not. Raise or lower the nose and/or tail of the aircraft sufficiently to allow the plumb bob to be aligned with the leveling plate after the plumb bob is allowed to settle.

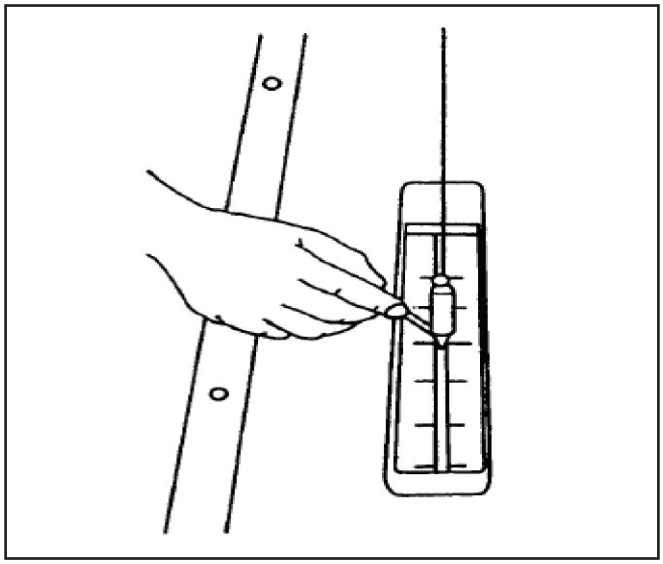


Figure 5-9 Plumb Bob

(a) Platform Leveling. Adjust 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.

(b) Top-of-Jack Leveling. While carefully maintaining a level attitude laterally and longitudinally, jack the aircraft until all tires are clear of the ground. Aircraft on jacks are leveled by strategically raising and lowering jacks to establish a level attitude.

c. Read and record the scale values and scale serial number of each reaction point.

d. For platform scales, tape and mark the center of each landing gear reaction point on the weighing facility floor. For load-cell-on-jack weighings the reaction points are known values in the aircraft coordinate system; therefore this step is not required.

(1) Longitudinal (and lateral) dimensions are determined by projecting reaction points to the hangar floor. Measurements between points will determine

required dimensions for computing CG. When using platform or flush scales, these points must be marked on the hanger floor prior to removing the aircraft from the scales. It is recommended that masking tape be used on the hanger floor for marking these points. Chalk lines can be snapped between points and measurements can be made after removing the aircraft from the scales.

(a) Reference Point Projection. Suspend a plumb bob from the center of the jig point, keeping the plumb bob approximately 1/8 inch above the floor. Dampen out the swing of the plumb bob and make a cross mark on the masking tape directly under the tip of the plumb bob. Print the words “jig point” on the masking tape, near the cross, to distinguish it from the other reaction points.

(b) Main Reaction Projections. Suspend a plumb bob from the center of each main reaction point (i.e., each main wheel) to the masking tape as described above. It is necessary that a free fall be obtained for the plumb bob, so interference shall be avoided. It is also necessary that the plumb bob be dropped from the exact center of the reaction point (i.e. drop the plumb bob from the center of the axle of both left and right main reactions).

(c) Nose or Tail Reaction Projections. 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 both left and right of the wheel). The nose or tail wheel shall be centered prior to dropping the plumb bob. These projections are then marked on the floor with a small cross.

(d) When reference/jig point and all reactions have been confirmed to be accurately projected to the hangar floor and marked, have the aircraft removed from the area.

e. Remove aircraft from scales and wait two minutes to allow the scale to return to a zero/tare state.

f. If scales do not return to zero, record as tare, and subtract or add to individual reactions’ weight. Enter (if applicable) manual altitude and latitude scale corrections and enter in Corrections block.

NOTE

If scale does not return to zero and value is positive, enter the correction as a negative value on Form B. If scale does not return to zero and value is negative, enter the correction as a positive value on Form B.

NOTE

Record any reasons for corrections in the remarks section of Form B (e.g., “scales did not return to zero,” or “brake-rider remained onboard for weighing.”)

When using stationary beam balance pit scales, the beam balance may be “upset” in lieu of removing the aircraft from the scales.

g. Measure dimensions for CG.

(1) Snap a chalk line between the two nose or tail reaction points. Taping down a string stretched between the two main reaction points can be used in lieu of a chalk line.

(2) Snap a chalk line or stretch a string between the two most outboard main reaction points. Repeat for each set of main gear fore/aft.

(3) Dimensions B and D shall be determined by measurement

CAUTION

Do not use the values tabulated in Chart E. These are only approximate. Use of Chart E values can induce significant errors into the weighing results.

NOTE

The measurements may also be taken by placing the 10” mark of the tape at the desired point and subtracting 10” from the final tape reading. This technique may allow easier swinging of the tape and lead to greater accuracy.

(4) All measurements should be taken with a steel tape measure. Two of the measurements are listed as "B" and "D" on the Form B - Aircraft Weighing Record. Dimension B is the perpendicular distance from projected jig point to the chalk line between the main reaction points. Dimension D is the distance from the chalk line between the main reactions to the nose or tail reaction point. When measuring these dimensions, the tape shall be parallel to the center line of the aircraft. These measurements shall be made accurately to a tenth of an inch or better to ensure accurate results of the computations which determine the as-weighed CG location of the aircraft. Measurements taken from the chalk line joining the main reaction points shall be measured perpendicular to the chalk line. These measurements may be determined quickly and accurately by placing the 10-inch mark of the tape on the desired point (the projection of the jig point or the projection of the nose (tail) reaction) and swinging the other end of the tape across the main reaction chalk line in a small arc. The

shortest dimension read off the tape where the tape crosses the chalk line is the perpendicular distance from the point to the line. Care shall be taken to ensure the measuring tape is clear of any obstacles, and is taut, straight, and perpendicular to the line or string when taking measurements.

h. Determine the Measured Basic Weight for this iteration, make appropriate corrections to the scale values, and Column I and II adjustments.

i. For platform scales only, determine the CG Measurements per the Form B Page 1 "MEASUREMENTS" section. These Measurements are the Dimensions required to calculate the as-weighed CG. Three dimensions shall be either measured or known to determine the longitudinal location of the as-weighed aircraft CG. The three dimensions are described as follows:

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

(2) The dimension from the jig point to a chalk line drawn between the main reaction points.

(3) The dimension between the main and nose reactions or main and tail reaction points.

NOTE

If lateral and/or vertical CGs are required, see aircraft specific manual for details.

j. If the Chart E requires multiple iterations, then rotate the scales between reaction points, and repeat steps 5.4.2a through 5.4.2h the appropriate number of times.

(1) Rotate the scales. This can help identify problems with individual scales as a possible source of error in the weighing results. Rotate the scales between the various reaction points (e.g., nose to left main, left main to right main, right main to nose). Rotations may be limited if different capacity scales are used between the nose and main gear. Check for consistency of readings at each reaction point. If a discrepancy is noted, it is possible or likely that one (or more) of the scales is out of calibration or otherwise not operating properly. If rotating the scales more than once, do not rotate back to the original position. A scale that gives inconsistent readings relative to the others at the same reaction point should be replaced, and the aircraft reweighed.

5.4.3 Compare the measured weight and CG against Weighing Tolerances.

a. If the measured weight and CG are within Weighing Tolerances of Table 5-1, complete the Form B and post the results to the Chart C. The Weighing is complete. Stow the weighing equipment and the aircraft can be removed from the weighing facility.

b. If the measured weight and CG are not within Weighing Tolerances and this is the first iteration, then complete all of the steps in Chapter 5.5.2.

(1) If errors were found, then make corrections and re-compare the measured weight and CG against Weighing Tolerances.

(2) If the revised measured weight and CG are within Weighing Tolerances, complete the Form B and post the results to the Chart C. The Weighing is complete. Stow the weighing equipment and the aircraft can be removed from the weighing facility.

(3) If the revised measured weight and CG are still not within Weighing Tolerances, rotate the scales (see 5.4.2.j (1)) between reaction points and repeat 5.4.2a through 5.4.2h.

(4) If on the second iteration, the measured weight and CG are still not within Weighing Tolerance, compare iteration 1 to iteration 2.

(5) Iterations are repeatable if they are within 0.25% in weight and arms are within 0.1% MAC for fixed-wing or within 0.1 inches for rotary-wing.

(6) If iterations 1 and 2 are repeatable, average the iterations, complete Form B, and post the results to Chart C. The Weighing is complete. Stow the weighing equipment and the aircraft can be removed from the weighing facility.

(7) If iterations 1 and 2 are not repeatable, complete a third iteration by repeating steps 5.4.2a through 5.4.2h. Compare all three iterations to determine repeatability. Average the two iterations that are within the repeatability tolerance, complete Form B, and post the results to Chart C. The Weighing is complete. Stow the weighing equipment and the aircraft can be removed from the weighing facility.

c. If after the third iteration results are not repeatable, then there is something wrong with the weighing preparation and iterations. Go back to 5.4.1 and start over.

5.5 VERIFICATION OF WEIGHING RESULTS

5.5.1 Compute the difference between the calculated weight and arm (last entry on Chart C) and the actual Basic Aircraft Weight and Arm to be posted to Chart

C (see Form B). If the weighing results are within the tolerances in Table 5-1, post the weighing to Chart C.

5.5.2 If the weighing results are outside of the tolerances in Table 5-1, verifi cation of results must be accomplished. The steps are listed in condensed form on DD FORM 365-2 PAGE 3. Each Verifi cation Step must be signed to ensure no error(s) occurred during the weighing.

a. Do not remove the aircraft from the weighing facility until all of the verification steps are complete.

b. Check calculations and measurements for errors.

c. Check scales for overdue calibration.

d. Check scales for correct altitude and latitude adjustments in accordance with the scale manufacturer's procedures.

e. Check slope of facility being used for weighing.

f. Check the accuracy of the level, inclinometer, or digital protractor.

g. Check and ensure that hangar doors are closed and that all fans and heaters are off.

h. Check the plumb bob to ensure it is properly positioned in the center of the V-notch of the locating bracket. Ensure that leveling tools reflect required longitudinal and lateral angles/alignment, if applicable.

i. Check aircraft (inside and out) to ensure that it is clean and completely dry.

j. Check to ensure chocks, flight gear, survival suits, fly-away gear, blade ropes, engine covers, and other non-Basic Weight items were removed.

k. Check that aircraft doors and panels were in proper configuration.

l. Check fuel tank sump drains for lack of fuel flow making sure an appropriate container is in place in the event of fuel discharge.

m. If authorized to weigh with full fuel tanks, check fuel quantity and density if aircraft was not defueled. Aircraft must be fueled using the gravity open-port refueling method to ensure maximum usable fuel capacity is achieved. Do not use aircraft fuel quantity indicators to determine the quantity. Use the applicable operator's manual for usable fuel capacities.

n. Check Chart C for errors since the last weighing.

(1) Verify that Chart A updates have been properly reflected in Chart C.

(2) Verify that all aircraft modifications have been accounted for.

(3) Verify Chart A inventory matches the aircraft's weighing condition.

(4) Ensure that any maintenance action taken place between when the aircraft was inventoried and when it was weighed has been accounted for.

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CHAPTER 6
WEIGHT AND BALANCE TOOLS

6.1 AUTOMATED WEIGHT AND BALANCE SYSTEM (AWBS).

6.1.1 General. AWBS may be authorized for maintenance of weight and balance records as directed by each Service Engineering Organization. (See Chapter 8 - Service Specific Requirements [Army 8.1.14, 8.1.15; Navy throughout 8.2; Air Force throughout 8.3; USCG 8.4]). Use of AWBS does not replace the user's knowledge of performing aircraft weight and balance nor does it alleviate the requirements of this manual for responsibility for accuracy of weight and balance data residing with the weight and balance authority. Ensure all calculations are correct and accurate.

a. AWBS is mandatory for some services, but not all. (See Chapter 8 - Service Specific Requirements [Army 8.1.14, 8.1.15; Navy 8.2; Air Force 8.3.14a; USCG 8.4]).

b. Each service is responsible for certification of software that automates the weight and balance records. See Chapter 8 - Service Specific Requirements [Army 8.1.14, 8.1.15; Navy 8.2.14k and 8.2.14l; Air Force 8.3.14e; USCG 8.4] for guidance on how and when to obtain the latest authorized software for each respective service.

6.1.2 AWBS Forms and Charts are designed to be used in lieu of paper DD 365 forms. AWBS is one example of electronic forms.

6.1.3 For detailed instructions using AWBS, reference help resources in the software application itself.

6.1.4 Electronic signatures are authorized in lieu of normal pen or stamp signatures. When selected, AWBS provides a feature that enables Weight and Balance personnel to electronically sign Chart C and Forms F using public key infrastructure (PKI) credentials. (See Chapter 8 - Service Specific Requirements [Army 8.1.1f; Navy 8.2.7d; Air Force 8.3.8d; USCG 8.4]).

6.1.5 The AWBS Central Server is a web service designed to store AWBS aircraft records and to enable the transfer, upload/backup and download/restore aircraft files. When correctly configured and with proper permissions, AWBS users can upload aircraft records to and download aircraft records from the Central Server. The Central Server acts as a central repository or transfer hub for aircraft records between operational units. (See Chapter 8 - Service Specific Requirements [Army 8.1.15a, 8.1.16a; Navy 8.2.14; Air Force 8.3.14; USCG 8.4]).

6.1.6 Only one user shall edit an aircraft record at a time to prevent data corruption.

6.1.6.1 US military services provide specific ways to obtain the software (See Chapter 8 - Service Specific Requirements [Army 8.1.15; Navy 8.2.14k and 8.2.14l; Air Force 8.3.14e; USCG 8.4]).

6.1.6.2 For contractors, contact your Contracting Officer's Representative (COR) or Defense Contract Management Agency (DCMA) representative. For Foreign Military Sales, contact your Security Assistance Command.

6.1.7 Distribution of AWBS.

6.2 OTHER WEIGHT AND BALANCE TOOLS.

6.2.1 Electronic Form F (i.e. Electronic Load Adjuster or Automated Form F (AFF) Generator).

6.2.1.1 Purpose. The requirements for digital methods that generate weight and balance data intended for use in completing the Form F for a specific aircraft type are defined below. The electronic Form F shall be developed to enable weight and balance personnel to (1) direct the load and (2) control the weight and CG of a particular aircraft type.

6.2.1.2 Authority for Use. All Electronic Forms F shall have the approval of the Service Engineering Organization that has responsibility for the baseline aircraft before it may be used. All program changes shall have prior approval before incorporation.

6.2.1.3 Objective. The objective of the Electronic Forms F is to replace the mechanical load adjuster and to eliminate the need to complete a paper DD Form 365- 4 Form F.

6.2.1.4 Calculations. The design data upon which Electronic Forms F is developed shall be based upon the aircraft manuals.

6.2.1.5 Program Changes. The program shall be written to prohibit field changes to the approved and validated program. This will ensure uniformity and allow program control and verification. To the maximum extent possible, the program shall be designed to allow for future

changes in the aircraft. For example, the original aircraft CG will change and new stores may be added to the list of items available for mission loading of the aircraft.

6.2.1.6 Ease of Operation. To the maximum extent possible, the program shall be designed for ease of use. Required keystrokes shall be minimized and required inputs shall be prompted by the program. Once the outputs have all been displayed, provisions will be made to redisplay them without repeating all of the user actions.

6.2.1.6.1 To facilitate ease of operations, the computer program should, to the maximum extent possible, follow the format of the Form F.. Calculated values on the form such as Operating Weight and moment, and Total Aircraft Weight and moment shall be determined by the program. Subsequent changes to a value used in determining a calculated value shall result in the calculated value being automatically updated. For example, once an initial calculation has been made, updating the fuel weight will result in correction of the gross weight.

6.2.1.6.2 To the greatest extent possible, the computer shall not require input of standard items. Thus if the computer is designed for a single type/design aircraft, the normal index or moment of standard items such as crew, oil, stores, etc. will be used by the computer and will not be entered by the user. To further facilitate ease of use, the computer may use input items such as compartments or stations which the user may readily know and which the computer will convert to the appropriate arm. Once an item has been input, the program will check the input value against acceptable limits to verify its validity.

6.2.1.7 Computational Requirements. The Electronic Form F shall be designed to provide rapid operation for the following:

a. Determination of the weight and CG location for any loading condition.

b. Adjust the CG for any increase, decrease, or relocation of fuel, passengers, crew, stores, or any other load.

c. Determine the required shift of fuel, passengers, crew or any other load item during flight operations to maintain the CG within the permissible limits.

d. Determine the CG limitations throughout the allowable weight range. If the CG is affected by other factors like wing movement, these factors shall be taken into account.

e. Calculation of In–flight weight and CG for standard fuel usage to ascertain CG does not go outside of the CG envelope for a proposed mission.

f. All aircraft limitations shall be included such as floor loading, compartment capacities, pylon capacity, operational environments, and caution zones.

6.2.1.8 Accuracy. The Electronic Form F shall contain weights and arms of individual loading data within 0.1 pounds and 0.1 inches compared to values in the applicable manuals (e.g. Chart E, Flight Manual, and Loading Manual). The Electronic Form F shall compute the displayed Weights, CG, and Simplified Moments to the nearest tenth.

6.2.1.9 Instruction Book. An instruction book shall be developed for each weight and balance Electronic Form F. This book shall contain detailed instructions for operating the Electronic Form F. Solutions to sample problems shall be included along with appropriate illustrations to improve clarity and effectiveness. This instruction book shall be submitted to the Service Engineering Organization for approval prior to use with the Electronic Form F.

6.2.2 Manual Form F Loading Tools.

6.2.2.1 Load Adjusters.

6.2.2.1.1 Purpose. The purpose of the adjuster is to enable the pilot, crew chief, or loading personnel (1) to direct the load and (2) control the CG location of a particular model aircraft. A load adjuster enables accurate and rapid determination that aircraft CG is within an acceptable range for any given loading condition. Load adjusters determine the effects of any weight or location changes necessary to keep the CG within a safe loading range for items such as crew, fuel and cargo.

6.2.2.1.2 Description. There are two types of load adjusters. The more common slide-rule type (see Figure 6-1) and the circular type. All load adjusters operate on the principle of the addition and subtraction of moments for CHART E load items to and from the aircraft basic moment. This is done through the use of the index number scale.

6.2.2.2 See aircraft specific manuals for more details concerning Load Adjusters.

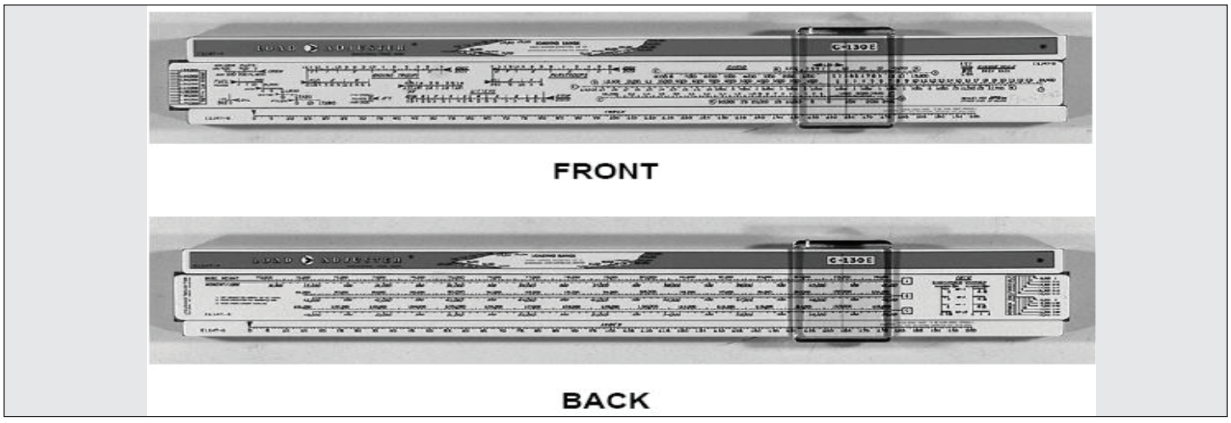

Figure 6-1. Load Adjuster

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CHAPTER 7
CENTER OF GRAVITY LOADING CALCULATIONS

7.1 GENERAL. The purpose of this Chapter is to outline the method for determining the CG of a loaded aircraft. Location of the CG is very important to safety of flight because CG limits can be exceeded. The CG can be controlled by proper loading of the aircraft. The CG is the point about which an aircraft would balance if it were possible to support the aircraft at that point. It is the theoretical point at which the entire weight of an aircraft is concentrated. Balance, or the location of the aircraft's CG, is of primary importance to aircraft stability.

7.1.1 For most aircraft the prime concern is longitudinal balance, or the location of the CG along a designated reference line running from the nose to the tail. Location of the CG with reference to the lateral (side to side) axis is also important for some aircraft. If an aircraft will be flown in an asymmetrical configuration, it is required to calculate the lateral CG. The design of most aircraft is such that symmetry is assumed to exist about a vertical plane through the longitudinal axis. In other words, for each item of weight existing to the left of the fuselage centerline there is generally an equal weight existing at a corresponding location on the right. This lateral mass symmetry however may be easily upset due to unbalanced lateral loading. Location of the lateral CG is not only important from the aspect of loading rotary wing aircraft, but is also extremely important when considering fixed wing exterior drop loads. If required by aircraft-specific manuals (such as flight manual, loading manual, Chart E, etc.), the lateral CG shall be computed when a lateral imbalance is present or when flying in an asymmetric configuration (see Figure 7-1). The CG (henceforth, reference to CG will mean the longitudinal center of gravity) is not necessarily a fixed point; its location depends on the distribution of items loaded in the aircraft, and as variable load items are shifted or expended, there is a resultant shift in CG location. It should be realized that if the CG of an aircraft is displaced too far forward on the longitudinal axis a nose heavy condition will result. Conversely, if the CG is displaced too far aft on the longitudinal axis, a tail heavy condition will result. It is possible that an unfavorable location of the CG could produce such an unstable condition that the pilot could lose control of the aircraft.

7.1.2 Lateral and vertical CGs are not controlled on most aircraft, but are restricted to limits of operation on some aircraft. If required, the data and procedures necessary for lateral and/or vertical CG control are called out in the applicable aircraft specific manuals. Some aircraft may also track moments of inertia.

Figure 7-1. Asymmetric Configurations

7.2 **PRINCIPLE OF MOMENTS**. A working knowledge of the principle of moments is necessary for understanding balance and for computing CG. For those unfamiliar with weight and balance terms, a moment is the product of a force or weight, times a distance. The distance used in calculating a moment is referred to as the arm or balance arm, and is usually expressed in inches. To calculate a moment, a force (or weight) and a distance must be known. (WAM: Weight x Arm = Moment) The distance is measured from a known reference point or reference datum to the point through which the force acts. A moment is meaningless unless the reference point is specified about which the moment was calculated.

7.2.1 For the purpose of illustration, an aircraft may be compared to a seesaw. Like the seesaw, in order for an aircraft to be in balance, or equilibrium, the sum of the moments on each side of the balance point must be equal in magnitude.

a. For example, referring to Figure 7-2, the moment produced about the fulcrum (reference point) by the 200 pound weight is 200 pounds x 50 inches = 10,000 inch- pounds counterclockwise.

b. The moment produced about the same reference point by the 100-pound weight is 100 pounds x 100 inches =10,000 inch-pounds clockwise.

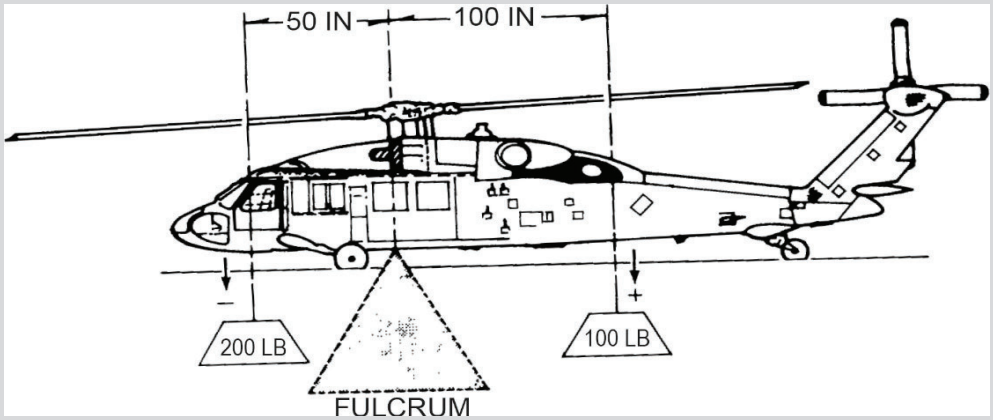

Figure 7-2. Aircraft Balance Part

c. In this case, the clockwise moment counterbalances the counterclockwise moment, and the system is in equilibrium. This example illustrates the principle of moments which is as follows: For a system to be in static equilibrium, the sum of the moments about a balance point equal zero.

7.2.2 As illustrated in Figure 7-2, the clockwise moment is arbitrarily given a positive (+) sign while the counterclockwise moment is given a negative (-) sign. Therefore, the sum of the moments about the fulcrum = +10,000 inch-pounds (clockwise) -10,000 inch-pounds (counterclockwise) which equals zero, and the system is in equilibrium. In determining balance of an aircraft, the fulcrum is the unknown, and the problem is one of determining the location of the fulcrum, or longitudinal center of gravity.

7.3 **EFFECTS OF MOMENT ON AIRCRAFT CG**. As in the case of the seesaw, which can be balanced about its fulcrum, an aircraft may be considered to be in balance about its CG. Loads placed forward of the aircraft CG can be balanced by placing loads aft of the CG. Loads located forward of the CG of an aircraft produce moments which tend to make the nose go down, whereas loads located aft of the CG produce moments which tend to make the tail go down. If any item is added forward of the CG or removed aft of the CG, a nose-heavy condition will result. Conversely, any item added aft of the CG or removed forward of the CG will produce a tail-heavy condition. It should also be realized that a moment can be changed without adding or removing a weight. Moments are changed, and therefore CG is changed, by simply shifting weight forward or aft.

7.4 **DETERMINATION OF BALANCE CONDITION (LOCATION OF AIRCRAFT CENTER OF GRAVITY)**.

To determine the CG location of loaded aircraft, it is first necessary to obtain the Basic Weight and moment of the aircraft from Chart C. Add the weight of the items to be loaded to the aircraft Basic Weight to obtain the Gross Weight. Compute the moment of each load item by multiplying its weight by its arm. Find the Gross Weight moment by adding the basic aircraft moment and the moments of the load items. Determine the CG location by dividing the Gross Weight moment by the Gross Weight. Figure 7-3 illustrates the method for determining the CG location of a loaded aircraft.

7.4.1 In computations, any item of weight added to the aircraft is a plus weight. Any weight item removed is a minus weight. Balance arms are positive when measured aft of the reference datum. Balance arms are negative when measured forward of the reference datum. When multiplying weights by arms, the moment is positive if the signs are either both positive or both negative. Moments are negative if the signs of weight and arm are opposite. The following combinations are possible:

a. Items added forward of the datum: (+) weight X (-) arm = (-) moment.

b. Items added aft of the datum: (+) weight X (+) arm = (+) moment.

c. Items removed forward of the datum: (-) weight X (-) arm = (+) moment.

d. Items removed aft of the datum: (-) weight X (+) arm = (-) moment.

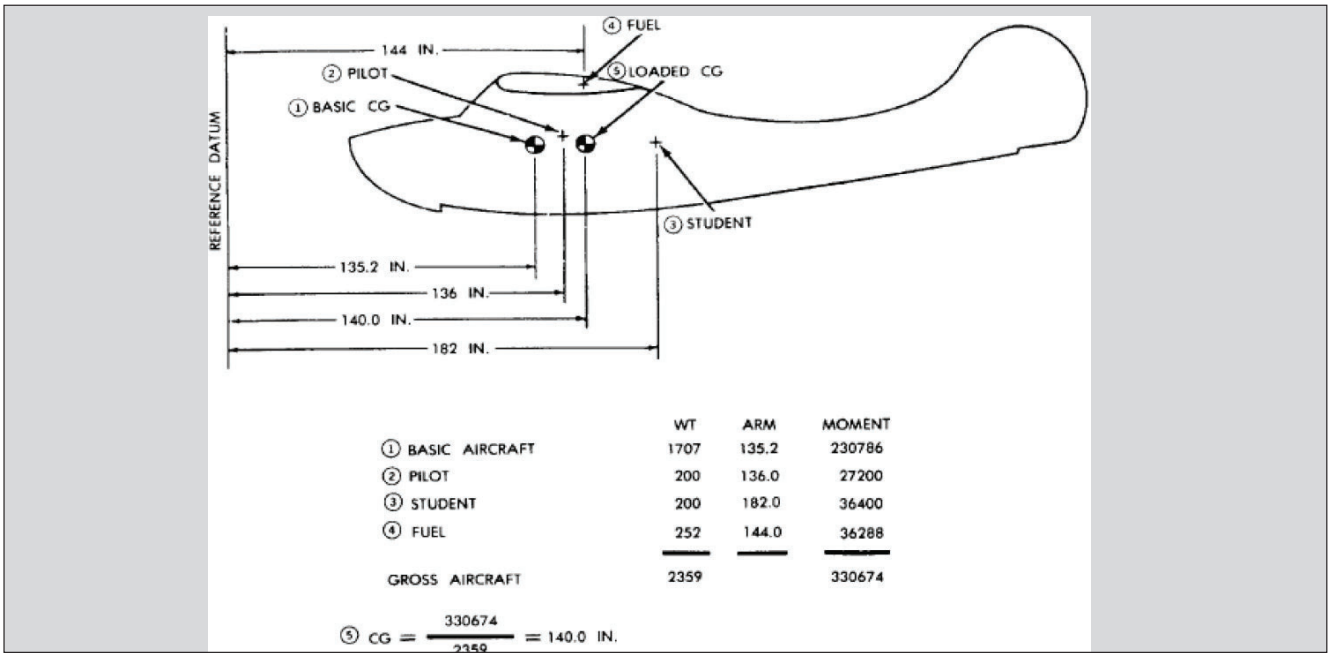

Figure 7-3. Calculating Aircraft Center of Gravity

7.5 **EFFECTS OF UNBALANCED LOADING**. When the aircraft is nose-heavy (CG too far forward), the pilot will experience difficulty in getting the nose up during landing. Other unfavorable conditions which may result are loss of aircraft maneuverability, overstress of the nose wheel structure in landing, and increase of pilot fatigue. When a tail-heavy condition exists (CG too far aft), the aircraft may become unstable. This condition increases pilot fatigue, and may lead to structural failure and spins.

7.6 **DETERMINING CENTER OF GRAVITY FOR A GROUP OF ITEMS.** It is sometimes desirable to find the average arm or CG for a group of objects in an aircraft. This is accomplished by finding the individual moment of each object in the group, adding these moments, and dividing this sum by the total weight of all the objects in the group. It is expressed by the formula:

$$\text{Average arm (in)} = \frac{\text{Total moment (inch pounds)}}{\text{Total weight (pounds)}}$$

It should be noted that basic aircraft weight and moment are excluded from this calculation. The total moment used in this formula must not be simplified.

7.7 **CENTER OF GRAVITY LIMITS.** All aircraft have allowable limits which the CG shall remain within for safe operations. After the CG of a loaded aircraft has been calculated, it is necessary to ensure that the CG falls within these allowable limits. These limits are specified in the applicable aircraft Chart E. If, after loading the aircraft, the CG does not fall within the allowable limits, it shall be necessary to shift loads.

7.7.1 The forward CG limit may vary with the Gross Weight of an aircraft. The forward CG limit is often restricted to control landing conditions. It may be possible for aircraft to maintain stable and safe for flight with the CG ahead of the forward limit as prescribed by landing conditions. However, since landing is one of the most critical phases of flight, the forward CG limit is restricted to avoid damage to the aircraft structure when landing, and to ensure that sufficient elevator deflection is available at minimum airspeed.

7.7.2 The aft CG limit is the furthest aft the CG is allowed. As the CG moves aft, the aircraft becomes less stable which reduces the ability of the aircraft to right itself after maneuvering or after disturbances by gusts. The allowable aft CG limit may also vary with the aircraft Gross Weight.

7.8 **EXPRESS CENTER OF GRAVITY**. The CG is expressed in terms of inches from a defined reference datum, or alternatively, in percent Mean Aerodynamic Chord (% MAC) for fixed-wing aircraft.

7.9 **LATERAL CG AND VERTICAL CG**. Typical aircraft cannot be loaded beyond lateral or vertical CG limits. Aircraft that can be loaded asymmetrically, whether intentional or not, can possibly exceed lateral CG limits. Some aircraft require strict monitoring of the CG (and inertia) in all three axes; not just longitudinal. The principles in the next paragraph apply to lateral and vertical balance as well as longitudinal balance. If required, the data and procedures necessary for lateral and/or vertical CG control are called out in the applicable aircraft specific Chart E and/or manual.

7.10 **MOST FORWARD AND MOST AFT CG CALCULATIONS**. These calculations are designed to determine the most forward and most aft CG locations that could normally occur during the mission under consideration. Each computed CG should be carried to at least one decimal place and checked against the allowable limits. As the Gross Weight changes due to fuel use, expendable ammo, crew or passenger movement, and the release of expendable stores, the allowable CG limits may change. If the CG exceeds the limits, note it in the calculations but do not begin correction until all the CG calculations are completed. Then make the necessary corrections and run through CG 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 CG calculations using load adjusters are included in Chapter 6 (Weight and Balance Tools).

7.10.1 Takeoff Gross Weight Condition. Prior to any mission CG calculations, a takeoff condition shall be determined. This is done by adding the various loading data weights and moment to the current Chart C Basic Weight and moment and computing the takeoff Gross Weight CG.

7.10.2 Landing Gear Retraction. Unless specifically stated in the Chart E, the takeoff condition is determined with the landing gear down. The raising of the landing gear causes an aircraft CG shift due to the moment change listed in the Chart E. If the Gear Up Moment Change (GUMC) is positive, raising the landing gear shifts the CG aft. As such, the gear-up condition is the aft CG condition and the gear-down condition is the forward CG condition. If the GUMC is negative, raising the landing gear shifts the CG forward. As such, the gear-up condition is the forward CG condition and the gear-down condition is the aft CG condition. In some cases, separate gear-up and gear-down CG envelopes are identified or provided. Ensure CG envelope matches gear position for calculations.

7.10.3 Fuel Use. Subtract from the forward and aft CG conditions the weight and moment for the usable fuel. The new weights and moments represent the forward and aft CG zero fuel conditions. Add to these conditions the partial fuel quantities (taken from the Chart E fuel tables) that cause the most forward and aft CG shifts. These quantities may not be explicitly called out, but need to be determined by trial and error. These calculations result in the forward and aft CG fuel use conditions. Compute the CGs.

NOTE

Determining the zero fuel CG is critical for determination of fuel loads that result in most-forward and most-aft CG conditions. The fuel load that causes the CG to shift furthest forward relative to the zero fuel CG is the fuel load that causes the most-forward CG condition. The fuel load that causes the CG to shift furthest aft relative to the zero fuel CG is the fuel load that causes the most-aft CG condition.

When fuel tables reflecting the effects of different aircraft attitudes (angles of attack) on the fuel CG are listed in the Chart E, these tables shall be evaluated along with the standard level flight fuel tables to determine the forward and aft CG fuel use conditions.

7.10.4 Expended Ammo. The CG movement caused by fi ring ammunition shall be considered. Subtract the weight and moment of the rounds carried from the two conditions derived in the previous paragraph and add the weight and moment of the retained ammo and cases, if any. Compute the new conditions CG and determine the direction of the CG shift. If the ammo used causes an aft shift when applied to the CG condition, the ammo used condition is the new aft CG condition. If the ammo used causes a forward CG shift when applied to the forward CG condition the ammo used condition is the new forward CG condition. If it causes a forward CG shift to the aft CG condition or an aft CG shift to the forward CG condition, the forward and aft conditions remain as before. If there is no apparent CG shift when applied to the forward (or aft) CG condition, then fi ring ammunition has no impact on forward and aft CG calculations.

7.10.5 Expending Stores. The calculations to determine the CG eff ect of the release of stores involves a number of computations covering each step of prescribed release sequence. If no sequence is prescribed for the mission, the sequences that cause the most forward and aft CG movement shall be determined and their effects calculated. The procedure is the same as described above for expended ammo.

7.10.6 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 fl ight. This movement can have considerable eff ect on the aircraft CG and should be evaluated. Included in the Chart E are tables that list moment changes resulting from the movement of standard weight personnel from one aircraft compartment to another. These moments are positive, or added, when the personnel movement is aft, while they are negative, or subtracted, when the movement is forward.

7.10.7 Corrections. Corrections shall be made if the calculated forward and/or aft CG falls outside the allowable CG limits. Some aircraft are equipped to carry variable ballast, which can be used to bring the CG within limits. In cargo, tanker, and transport aircraft, the CG 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 use and store release. However, whenever corrections are made, the mission calculations shall be modified and checked so that CG limits are not exceeded in other parts of the mission profile.

NOTE

Typically, a negative CG change is used to represent forward movement and a positive CG change is used to represent aft movement. A negative weight shift would result in removing weight.

7.10.8 Shift Equation. When the CG of a loaded aircraft does not lie within the prescribed limits, and certain load items can be moved about, the CG 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:

$$(W_{SHIFT})(\Delta CG_{WS}) = (W_{TOTAL})(\Delta CG_{AC})$$

where:

$W_{SHIFT} = weight\ of\ shifted\ item\ (pounds)$

$\Delta CG_{WS} = distance\ that\ item\ is\ shifted\ \ (inches)$

$W_{TOTAL} = total\ weight\ of\ aircraft\ including\ the\ shifted\ item\ (pounds)$

$\Delta CG_{AC} = change\ in\ total\ aircraft\ CG\ due\ to\ shifted\ item\ (inches)$

a. To find how much weight needs to be shifted a known distance (ΔCG_{WS}) to attain the desired CG change (ΔCG_{AC}) (an example is shown in Figure 7-4):

$$W_{SHIFT} = \frac{(W_{TOTAL})(\Delta CG_{AC})}{\Delta CG_{WS}}$$

b. To find how far to shift a known weight (W_{SHIFT}) to attain the desired CG change (ΔCG_{AC}) (an example is shown in Figure 7-5):

$$\Delta CG_{WS} = \frac{(W_{TOTAL})(\Delta CG_{AC})}{W_{SHIFT}}$$

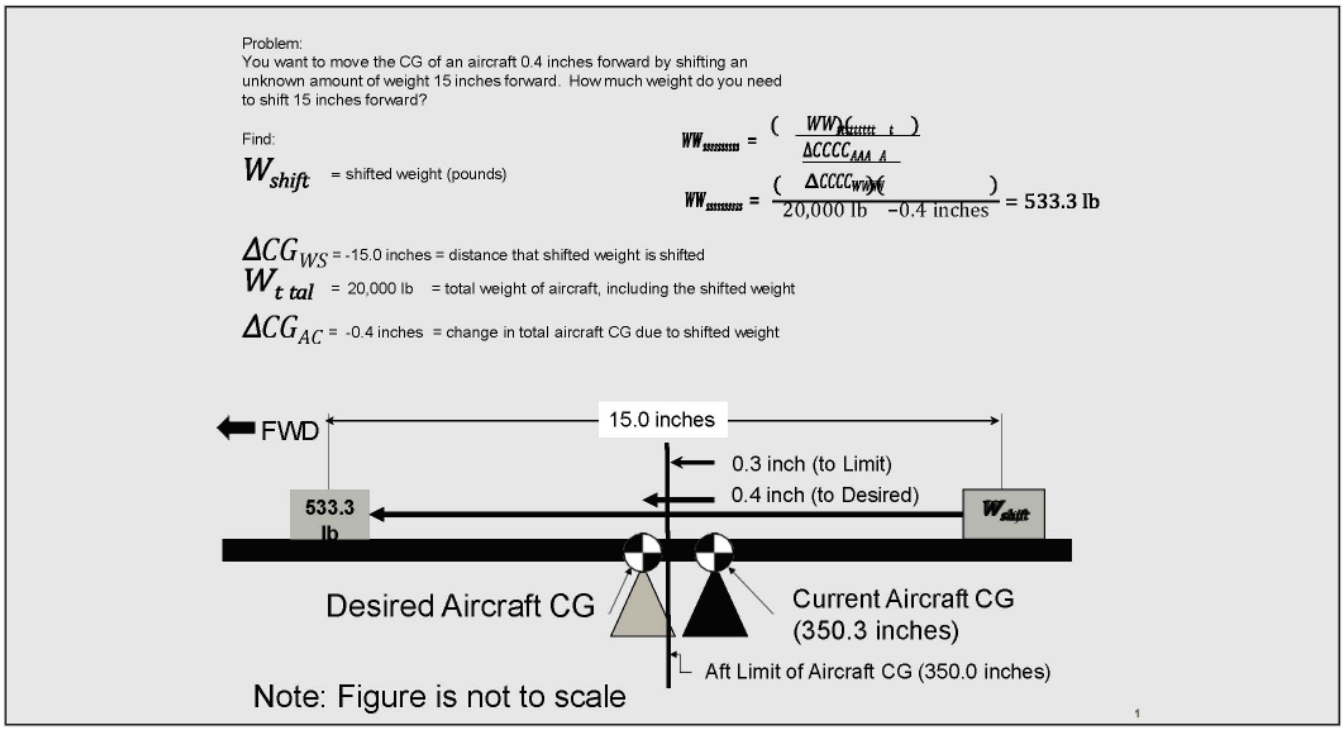

Figure 7-4. Example: Shift Unknown Weight A Known Distance

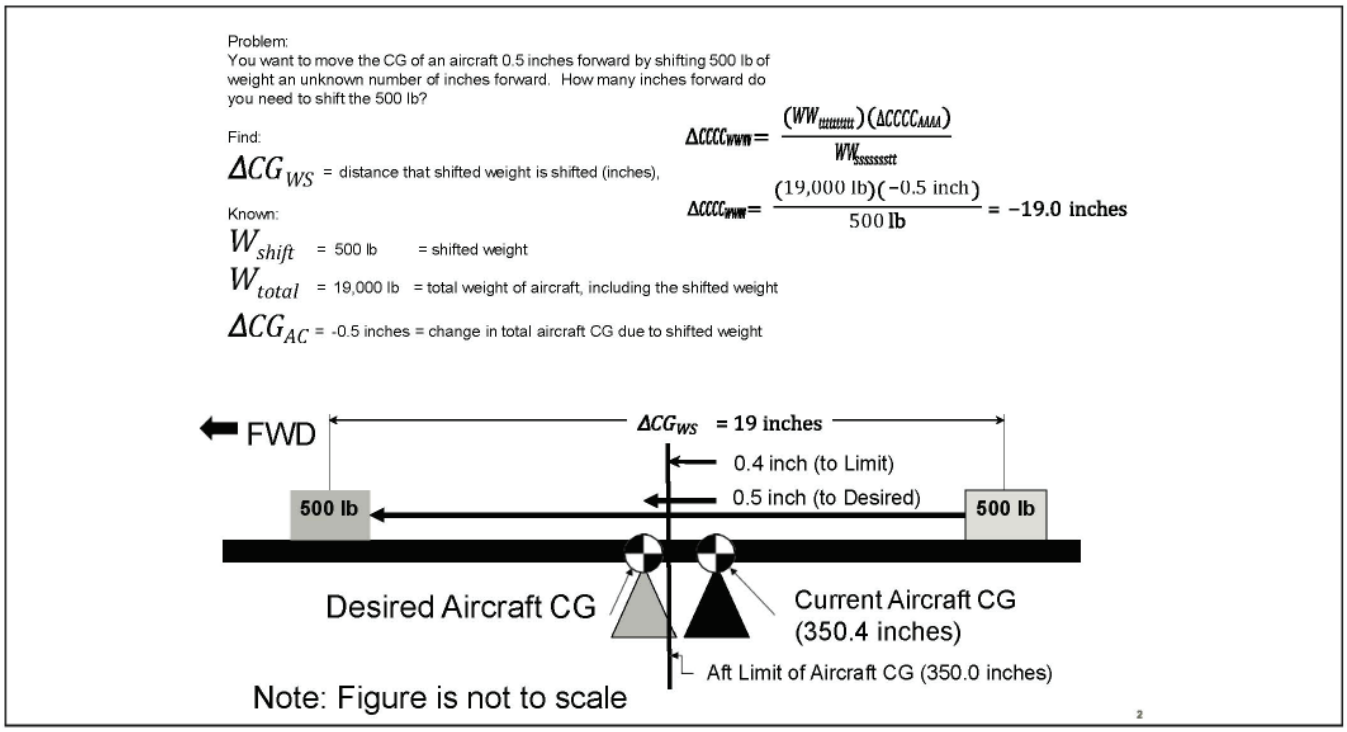

Figure 7-5. Example: Shift Known Weight an Unknown Distance To Achieve Desired Effect On Aircraft CG

7.10.9 Ballast Placement Equation. The following equation can be manipulated to determine the proper location for placement of temporary ballast:

($W_B(CG_B - CG_D) = (W_G)(CG_D - CG_{GW})$

Where:

CG_B = CG of temporary ballast (inches)

W_G = aircraft weight excluding ballast (pounds)

W_B = ballast weight (pounds)

CG_D = desired aircraft CG with ballast (inches)

CG_{GW} = aircraft CG without ballast (inches)

a. To find the balance arm (*CG_B*) where temporary ballast (*W_B*) needs to be added in order to move the aircraft CG to a desired location (an example is shown in Figure 7-6):

$$CG_B = CG_D + \frac{(W_G)(CG_D - CG_{GW})}{W_B}$$

b. To find the amount of temporary ballast (WB) that needs to be added at a known balance arm (CGB) to move the aircraft CG to a desired location (an example is shown in Figure 7-7):

$$W_B = \frac{(W_G)(CG_D - CG_{GW})}{(CG_B - CG_D)}$$

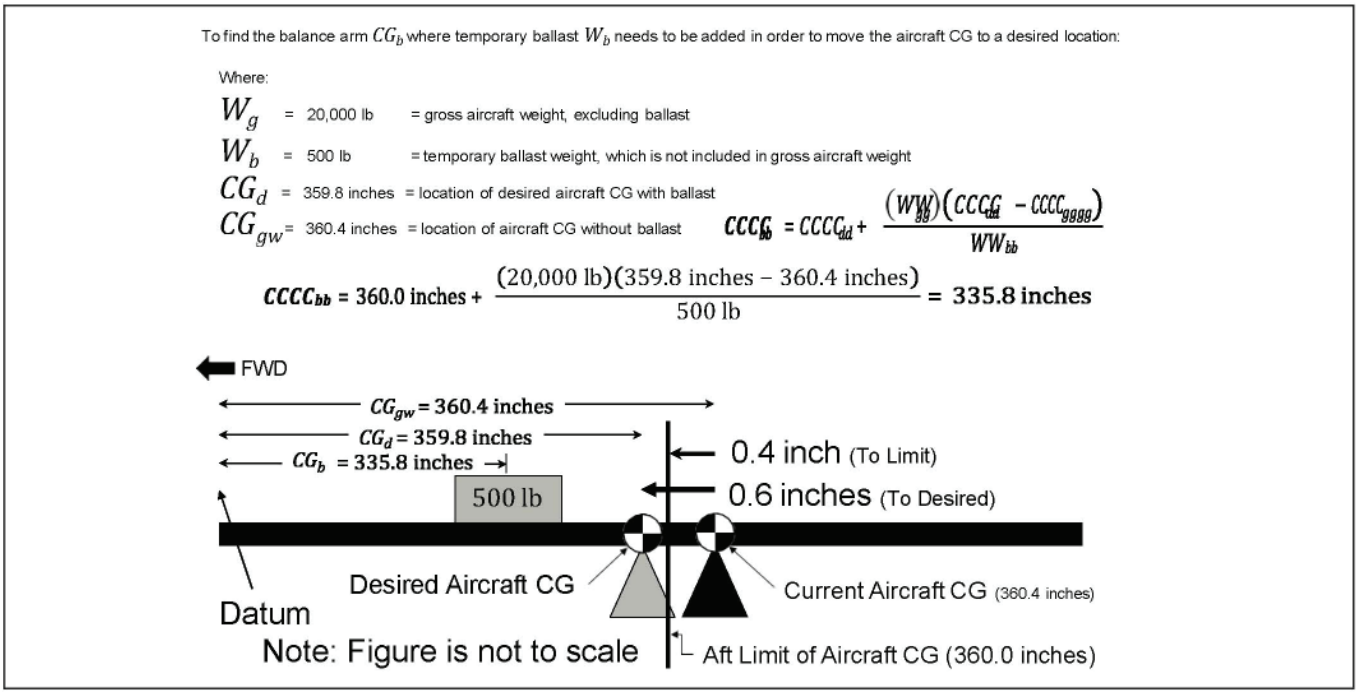

Figure 7-6. Example: Determine Required CG of Known Ballast Weight to Achieve Desired Effect on Aircraft CG

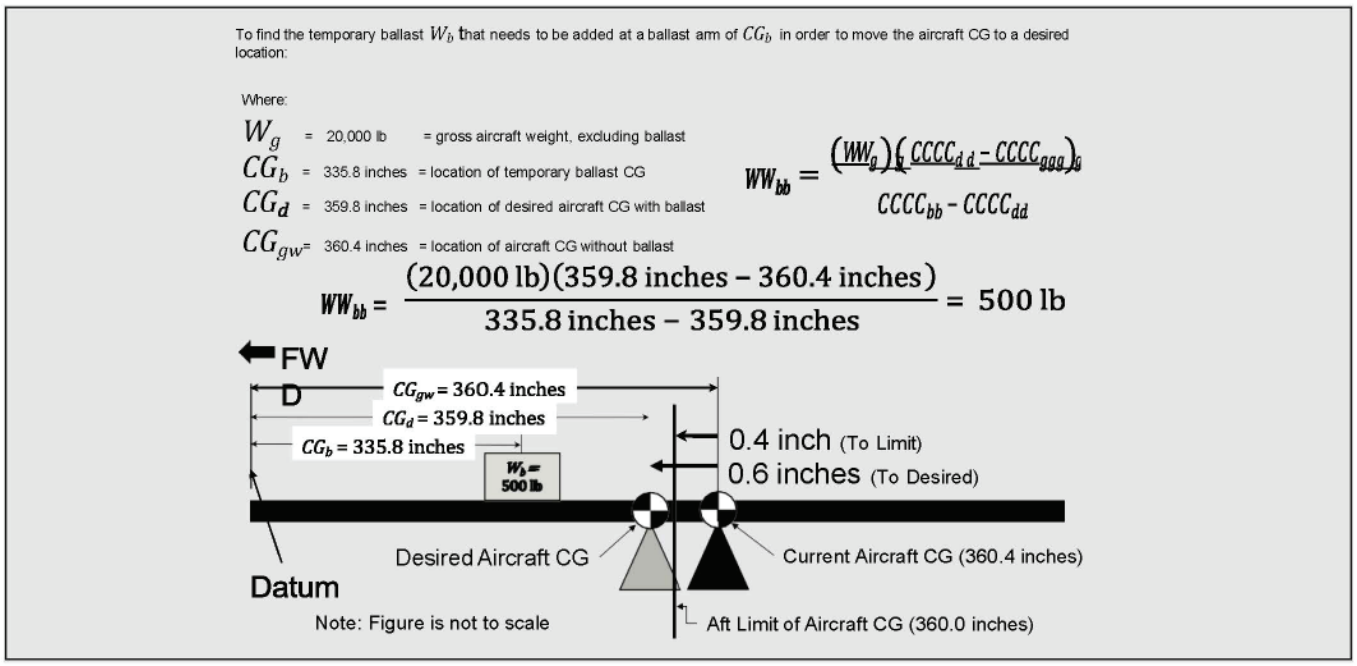

Figure 7-7. Example: Determine Required Ballast Weight at a Known CG to Achieve Desired Effect on Aircraft CG

7.11 Sample: This sample deals with a FX-1 air superiority configured aircraft. It is armed with four AIM-13J missiles and full ammo, and also carries chaff and flares. The Basic Weight from the Chart C is 15,000 pounds with a moment of 50,000 inch-pounds/100. The forward CG limit is 20.0 percent MAC up to 20,000 pounds, and then increases linearly to 30.0 percent MAC at 40,000 pounds. The aft CG limit is constant at 50.0 percent MAC. The MAC and leading edge of the MAC (LEMAC) are 150.0 and 250.0 inches, respectively. Percent MAC is defined as:

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

7.11.1 The takeoff condition is derived as follows:

	Weight	Mom/100
BASIC WEIGHT	**15, 000**	**50, 000**
PLUS:		
Crew (1)	200	300
Ammo (retained)	100	325
Ammo (expendable)	150	400
Full Fuel	7,500	17,500
Adapter @ BL 150	50	200
Launcher @ BL 150	150	50
AIM-13 @ BL 200	350	1,000
AIM-13 @ BL 150	350	1,000
Chaf/Flares	25	100
TAKEOFF CONDITION	**23,875**	**71,325**
CG - (71,325 x 100) / 23,875	298.7 inches	

$$\%\ \text{MAC} = \frac{(298.7 - 250.0)}{150.0} \times 100 = 32.5\ \%\text{MAC}$$

7.11.2 The landing condition is defined as minus all expendable stores and with 1,000 pounds of fuel remaining.

	Weight	Mom/100
TAKEOFF CONDITION	**23,875**	**71,325**
MINUS:		
AIM-13 @ BL 150	-350	-1,000
AIM-13 @ BL 200	-350	-1,000
Ammo (expendable)	-150	-400
Full Fuel	-7,500	-17,500
PLUS:		
1, 000 pounds Fuel	1,000	900
LANDING CONDITION	**16,525**	**52,325**
CG = (52,325 x 100) / 16,525	316.6 inches	

$$\%\ \text{MAC} = \frac{(316.6 - 250.0)}{150.0} \times 100 = 44.4\ \%\text{MAC}$$

7.11.3 The takeoff CG and landing CG are thus within the allowable limits.

7.11.4 The next step is to make the calculations described for the most forward and most aft center of gravity.

a. The landing gear retraction is defined in the Chart E as causing a minus 15,000 inch-pound moment change. Thus, the aft CG condition remains at the takeoff condition, while the forward CG condition becomes:

	Weight	Mom/100
TAKEOFF CONDITION	**23,875**	**71,325**
Landing Gear Retract		-150
FORWARD CG CONDITION	**23,875**	**71,175**
CG = (71,175 x 100) / 23,875	298.1 inches	

$$\% \text{ MAC} = \frac{(298.1 - 250.0)}{150.0} \times 100 = 32.1 \text{ \%MAC}$$

(1) The fuel condition that will produce the most aft CG shift is determined to be 2,000 pounds and 5,800 inch-pounds/100.

	Weight	Mom/100
AFT CG CONDITION	**23,875**	**71,325**
MINUS:		
Full Fuel	-7,500	-17,500
PLUS:		
2,000 pounds Fuel	2,000	5,800
NEW AFT CG CONDITION	**18,375**	**59,625**
CG = (59,625 x 100) / 18,375	324.5 inches	

$$\% \text{ MAC} = \frac{(324.5 - 250.0)}{150.0} \times 100 = 49.7 \text{ \%MAC}$$

The most forward CG shift is caused by 6,000 pounds of fuel and 15,000 inch-pounds/100 of fuel.

	Weight	Mom/100
FWD CG CONDITION	**23,875**	**71,325**
MINUS:		
Full Fuel	-7,500	-17,500
PLUS:		
6,000 pounds Fuel	6,000	15,000
NEW FWD CG CONDITION	**22,375**	**68,825**
CG = (68,825 x 100) / 22,375	307.6 inches	

$$\% \text{ MAC} = \frac{(307.6 - 250.0)}{150.0} \times 100 = 38.4 \text{ \%MAC}$$

b. The expendable ammo is located forward of the forward CG limits, so the forward CG condition remains with full ammo as in previous paragraph. The new aft CG condition is derived to reflect ammo used (the FX-1 retains ammo cases).

	Weight	Mom/100
AFT CG CONDITION	**18,375**	**59,625**
MINUS:		
Ammo (expendable)	-150	-400
NEW AFT CG CONDITION	**18,225**	**59,225**
CG = (59,225 x 100) / 18,225	325.0 inches	

$$\% \text{ MAC} = \frac{(325.0 - 250.0)}{150.0} \times 100 = 50.0 \text{ \%MAC}$$

c. The four AIM-13 missiles are located aft of the aft CG limit, so their firing causes a forward CG shift. The new forward CG condition then becomes:

	Weight	Mom/100
FWD CG CONDITION	**22,375**	**68,825**
MINUS:		
AIM-13 (4)	-700	-2,000
NEW FWD CG CONDITION	**21,675**	**66,825**
CG = (66,825 x 100) / 21,675	308.3 inches	

$$\% \text{ MAC} = \frac{(308.3 - 250.0)}{150.0} \times 100 = 38.9 \text{ \%MAC}$$

The aft condition remains with the four missiles as before.

7.11.5 Thus, Thus, both the forward CG and aft CG are within the allowable limits. However, suppose the pilot weighed in at 150 pounds, instead of 200. That would mean a 50 pound weight reduction, and a 7,500 inch-pound moment reduction from what was calculated. With the pilot being forward of the MAC, the CG shift would be aft. The new aft CG condition would then be:

	Weight	Mom/100
AFT CG CONDITION	**18,225**	**59,225**
MINUS:		
Crew Weight Reduction	-50	-75
NEW AFT CG CONDITION	**18,175**	**59,150**
CG = (59,150 x 100) / 18,175	325.4 inches	

$$\% \text{ MAC} = \frac{(325.4 - 250.0)}{150.0} \times 100 = 50.3 \text{ \%MAC}$$

This is 0.3 percent MAC aft of the allowable aft CG limit. Thus, the calculations could have been performed and clearance given to the flight using the standard pilot weight, but because of the lighter weight pilot, the aircraft CG could have gone aft of the aft limit in flight.

7.12 Chart E Loading Data. The Chart E provides all the weight, arm, and moment data necessary to perform CG loading calculations. It is predominately 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 nominal values based on an average sample. Variability in weight for payload items is expected. Actual weights should be used whenever possible, especially when dealing with variable items such as the fuel (density varying with temperature) and the crew.

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CHAPTER 8
Service Specific Requirements

8.1 US ARMY REQUIREMENTS

NOTE

Additional requirements may be provided in AR 95-1 and AR 95-20.

8.1.1 Related References.

a. AR 95-1 Aviation Flight Regulations.

b. AR 95-20 Contractor's Flight and Ground Operations.

c. DA PAM 738-751 Functional User's Manual for the Army Maintenance Management System - Aviation (TAMMS-A).

d. TB 43-180 Calibration and Repair Requirements for the Maintenance of Army Materiel.

e. TB 750-25 Maintenance of Supplies and Equipment Army Test, Measurement, and Diagnostic Equipment (TMDE).

f. TM 1-1500-328-23 Aeronautical Equipment maintenance Management Policies and Procedures.

8.1.2 Weight and Balance Control. Operational aircraft weight and balance control shall be accomplished in accordance with the detailed requirements and instructions of the specific aircraft maintenance manuals, applicable regulations, and the requirements of this manual. In case of conflicting requirements, procedures, or instructions, US Army regulations and aircraft maintenance manuals shall take precedence over this manual.

NOTE

For some aircraft it may be possible to have a completely electronic Weight and Balance handbook if authorized by the appropriate Command and approved by the Weight and Balance Authority. However, a current backup (CD, Server, etc.) will be maintained at all times to prevent loss of data.

a. All weight and balance records will, as a minimum, be reviewed every 12 months. The last day of the month is the final day for completing the review. For example, if the previous review was completed on 8 April, the next review must be completed by 30 April of the following year. This review must include a weight and balance inventory of the aircraft and the following statement entered on the DD Form 365-3: "Calculated weight and moment per inventory completed at." The date and adjusted basic weight and moment will accompany this entry.

(1) DD Form 365, Record of Weight and Balance Personnel: Verify the last line entry indicates the person who is currently responsible for maintaining the aircraft's weight and balance handbook.

(2) DD Form 365-1, Chart A - Basic Weight Checklist Record: This review must include a Chart A inventory of the aircraft and the following statement entered on the Chart C: "Calculated Weight and Moment per inventory completed at (inventory location)".

NOTE

Part numbers should be confirmed whenever practical during inventory of Chart A items.

(3) DD Form 365-2, Form B - Aircraft Weighing Record: Verify Basic Weight, Arm, and Moment match the last weighing on Chart C. Verify the associated inventory and weighing dates match.

(4) DD Form 365-3, Chart C - Basic Weight and Balance Record: Verify that all appropriate aircraft modifications entered on DA Forms 2408-5, 2408-5-1, and 2408-15 have been documented on the Chart C.

(5) DD Form 365-4, Weight and Balance Clearance Form F: Inspect all associated Forms F for accuracy of items listed, weights, and locations. Ensure forms reflect the appropriate configurations in which the aircraft may be operated, and that copies are located in the aircraft logbook.

(6) Upon satisfactory review of all weight and balance records and aircraft historical records, re-certify the records by entering on the Chart C the following statement. "Annual review of all weight and balance records completed at (inspection location)." The Basic Weight, Arm, and Moment will accompany this entry.

b. Temporary Equipment Changes. When equipment is installed, removed, or relocated within the aircraft for a period of less than 90 days, the weight and balance change(s) must be documented. If the cumulative temporary changes and Chart C changes not reflected on the Forms F result in a change of greater than or equal to +/- 0.3% in aircraft Basic Weight or 0.3 inches in aircraft Basic Arm, update or create new Forms F. Otherwise, document the change(s) by one of the following methods:

(1) Create new or update current Forms F.

(2) Make appropriate entries in aircraft maintenance records (DA Form 2408-13-1) containing a brief description, weight, arm, and moment of the changes.

c. Temporary Equipment Changes Exceeding 90 Days. When temporary changes entered in aircraft maintenance records exceed 90 days, enter a correction and sign off the DA Form 2408-13-1 entry after performing one of the following:

(1) For basic weight items, document the change(s) on the Chart A (if applicable) and Chart C. For load items, document change(s) on the Form F.

(2) Reinstall all items removed, remove all items installed, and relocate all items moved as part of the change(s).

8.1.3 Responsibilities.

a. Training Group. Refer to AR 95-1 and AR 95-20.

b. Sustainment Level Maintenance. N/A. Follow instructions in paragraph 3.4.

c. Type Commander. Refer to AR 95-1 and AR 95-20.

8.1.4 Personnel Qualification Requirements. Refer to AR 95-1 and AR 95-20.

8.1.5 Forms and Records Disposition. Weight and balance forms are to be safeguarded and maintained with the same degree of importance as other records maintained for each aircraft.

a. The individual weight and balance forms serve various purposes. Therefore, the retention period of the forms will vary, as follows:

(1) The DD Form 365, Record of Weight and Balance Personnel is a semi-permanent form. It will be retained in the aircraft's weight and balance data file until space for additional entries has been exhausted and a new replacement form started. At the time, the replaced form may be destroyed locally.

(2) The DD Form 365-1, Chart A - Basic Weight Checklist Record (Chart A) and the DD Form 365-3 Chart C - Basic Weight and Balance Record (Chart C) are permanent forms. These forms will be retained in the aircraft's weight and balance data file for the life of the aircraft. As new forms are started because of exhausting entry space, the new forms will be stapled to the original form.

(3) The DD Form 365-2, Form B - Aircraft Weighing Record (Form B) is a semi-permanent form. The current completed form will be retained in the aircraft's weight and balance data file until the aircraft has been reweighed, a new form started, computations verified, and necessary entries made on the Form B. Upon completion of the above, the old Form B may be destroyed locally.

(4) The DD Form 365-4, Weight and Balance Clearance Form F (Form F) which has been used to compute standard loads, utilizing the aircraft's current Basic Weight, is considered a current work form as long as the load weights and locations remain current and until the Basic Weight has been recomputed/changed. A copy of the current form will be retained in the aircraft's weight and balance file until the entries require revision, at which time the old form will be destroyed locally or marked void.

(5) Chart E, Loading Data and Special Weighing Instructions. The Chart E is considered a semi-permanent chart and is to be retained in the aircraft's weight and balance file until a revised Chart E is published in the aircraft maintenance and operator's manuals. Following publication of the Chart E in these manuals, the Chart E in the aircraft file is no longer required and shall be removed and destroyed locally.

b. The weight and balance file shall be maintained and kept current for each aircraft from the time of delivery of an aircraft to the Army until salvage or retirement of the aircraft. Upon transfer of an aircraft, the commanding officer of the transferring activity is responsible for ensuring the weight and balance file accompanies the aircraft.

c. Any of the DD Form 365 series can be duplicated for reason of replacing lost, mutilated, or illegible forms. Duplication of lost or illegible forms requires a

physical inventory for Chart A, weighing the aircraft, posting results to Chart C, and completion of Forms F.

d. The aircraft weight and balance file for aircraft stricken from the Army inventory is to be disposed of as follows:

(1) Destroyed/damaged aircraft. Destroy file locally, after necessary investigation and reporting, provided the aircraft does not fall into any of the following categories:

(a) Weight and balance records of aircraft that have been involved in accidents resulting in death or injury to any person, and/or damage to other than Government property that is classified as combat loss IAW AR 385-40, paragraph 2-5, are to be disposed of IAW Final Disposition Instructions issued by AMCOM, AMSAM-MMC-MA-OS. If the loss is not classified as combat loss IAW AR 385-40 paragraph 2-5, the weight and balance records are to be stored and secured with the wreckage and treated as legal evidence IAW DA Pam 27-162. The period of retention is variable. Final Disposition Instructions will not be issued from AMCOM until a letter of release is issued by controlling Staff Judge Advocate (SJA), with AMCOM legal review and concurrence.

(b) The weight and balance file shall accompany the aircraft to the acquiring agency or individual(s) for aircraft which are uneconomically repairable, under disposal conditions, or will be transferred or offered for sale to other than an Army custodian.

(c) Excess aircraft. For aircraft whether in a serviceable or repairable condition which are to be transferred or offered for sale to other than Army custody, the weight and balance file will accompany the aircraft to the acquiring agency/ individual(s).

8.1.6 Form F.

a. Procedures. Use current aircraft operator's manual and applicable Airworthiness Releases (AWRs) to complete and maintain Forms F.

b. All assigned Forms F shall be reviewed for accuracy every 90 days. The inspection due date window shall follow TM 1-1500-328-23 requirements for Recurring Special Inspections.

c. For test/developmental equipment installations/ removals, entries may be recorded on the Form F for the duration of the test/development.

NOTE

When aircraft are operated at critical gross weights or near CG limits, the actual weight and location of each individual occupant, equipment, and all load items will be used.

d. Entry of Taxi Fuel is not necessary unless required to bring aircraft into safe CG and/or weight range.

e. Weight and Balance Authority Signature Block. Enter signature, electronic signature, or technical inspector stamp of the person assigned to aircraft IAW DD Form 365.

NOTE

Local Commander may establish policies and procedures allowing deviation from the weight and balance authority signature.

f. Standardized Loading (CANNED Form F). N/A.

g. Form F. The following Warning, Cautions, and Notes apply to the Form F.

WARNING

Verify on-board flight performance system (e.g. Perf Page, FMS, CAAS) Basic Weight and Moment/Simplified matches Reference 1 of the current record DD Form 365-4, Weight and Balance Clearance Form F.

CAUTION

Fixed-wing aircraft need to be aware of potential CG shifts during flight due to Gear Up Moment Changes (GUMC), movement of personnel, expenditures of cargo, ordnance, and armaments. Special care is required for computing Takeoff CG (Gear Up) and Landing CG (Gear Up) to mathematically represent the entire flight from takeoff to landing.

NOTE

Aircraft with non-retractable landing gear should use/verify the following limitations: Takeoff Weight Limit, Landing Weight Limit, Takeoff CG (Gear Down), and Landing CG (Gear Down). Aircraft with retractable landing gear should also use/verify Ramp Weight Limit (if applicable), Takeoff CG (Gear Up) and Landing CG (Gear Up). Zero Fuel WT and CG limits may require computing IAW the aircraft operator's manual.

8.1.7 Aircraft Weighing.

a. Aircraft Weighing Requirements.

(1) Each aircraft will be weighed IAW this technical manual's Section 3 and when the period since the previous weighing reaches 36 months for a Class 1 aircraft and 24 months for a Class 2 aircraft. The date due reweigh window shall follow TM 1-1500-328-23 requirements for Recurring Special Inspections.

(2) Each aircraft will be weighed when Overhaul or Major airfrmae repairs are accomplished. For example, the following actions constitute a major overhaul: extensive airframe repairs, RESET, tail boom replacement, etc.

(3) Alternate Weighing Methods Contact Service Engineering Organization POCs listed in paragraph 8.1.13.

b. Other Authorized Weighing Facility. N/A.

c. Combat Aircraft Weight and Balance Management.

(1) Special circumstances exist in deployed locations which prevent ideal conditions for weighing. For those aircraft deployed within the theater of operations, weighing of aircraft is permitted in an open hangar if the following conditions are met:

(2) There is no risk of aircraft failing off jacks (if used) due to air movement.

(3) Scale readings do not change for a minimum of 30 seconds prior to recording the weight.

d. Weighing Deferments. 90-day combat weighing deferment.

(1) The unit commander (or designated representitive) may request a 90-day weighing deferment when operating in a combat theater. Send request with brief explanation why the aircraft cannot be weighed along with the copy of the aircraft's weight and balance file to the supporting Liaison engineer (LE). If the LE is not available, send request to the appropriate POC in Paragraph 8.1.13.

e. Aircraft Weighing Area.

(1) When floor slope is questionable, contact supporting Department of Public Works (DPW) or servicing agency for hangar floor survey. For a field expedient method, contact supporting unit Logistics Assistance Representative (LAR).

f. Aircraft Fuel System.

(1) Prepare aircraft fuel tanks in accordance with applicable maintenance manuals (alternate source is Chart E instructions). Weighing aircraft with full fuel tanks is not recommended and in some instances not authorized.

(2) Unusable and trapped fuel shall be listed on the Chart A as separate entries.

(3) If the aircraft is weighed with drained fuel tanks, unusable fuel listed on the Chart A will reflect "IN A/C" and the data also entered on the Form B, Column II.

(4) If the aircraft is weighed with a totally dry fuel system(s), unusable and trapped fuel listed on the Chart A will reflect "IN A/C" and the data also entered on the Form B, Column II.

(5) If the aircraft is weighed with full fuel tanks, fill the tank(s) to capacity using the gravity open-port method. The weight of usable fuel must be entered under Column I on the Form B. Usable fuel is not part of Basic Weight. Never weigh an aircraft with partially filled fuel tanks.

(6) Allow sufficient time for fuel temperature and movement to stabilize after refueling and aircraft positioning for weighing. 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. Float hydrometer in a sample of fuel from each tank just prior to weighing and record the weight per gallon; read this value at the lowest point of the meniscus (see Figure 5-4).

g. The following actions must be performed prior to aircraft weighing (in addition to this joint manual and aircraft specific requirements).

(1) Review aircraft logbook forms and records (DA Form 2408-13-1 and DA Form 2408-14-1) to ensure all aircraft parts/items are installed prior to weighing.

(2) Review aircraft historical forms and records (DA Form 2408-5 and DA Form 2408-5-1) and the Chart C to ensure all applied modifications has been properly documented on all appropriate forms and records.

h. The Weight and Balance Technician/Custodian assigned to the aircraft IAW the DD Form 365 shall ensure that all required parts/items are installed on the aircraft prior to record weighing.

8.1.8 Transfer and Acceptance of Aircraft. Both are required.

a. The weight and balance authority will transfer when one or more of the following occur:

(1) Aircraft is transferred/received to a new organization.

(2) Work ordered to next level maintenance which results in the weight and balance records requiring updates. An update constitutes any entries made to the Chart C.

b. The Chart A inventory shall be performed whenever:

(1) The aircraft is transferred to a new unit with a change of weight and balance authority.

(2) The Weight and Balance Technician receiving the aircraft shall perform a Chart A inventory of the aircraft to ensure the delivery condition or assumed operating condition recorded by the manufacture in Charts A and C matches the actual operating condition to be used by the custodian. If not, the necessary adjustments shall be made.

(3) The pilot reports unsatisfactory flight characteristics with weight and/or balance implications.

(4) The aircraft is weighed.

(5) At time intervals required by regulation.

8.1.9 Scales.

a. Scale Calibration. Commanders of Army organizations which operate, maintain, or modify aircraft are responsible for ensuring that weighing equipment under their jurisdiction are calibrated periodically and certified by a government inspector of weights and measures or by commercial scale officials in accordance with TB 750-25 and TB 43-180. Unless directed in these TBs, scales shall be calibrated or certified correct at least once every 12 months.

b. Scale Accuracy. All scales utilized to weigh USA aircraft and components shall be calibrated to 0.1 percent of the applied load between 10% and 90% of capacity. For deviation from the scale accuracy requirement contact the LE or POCs listed in paragraph 8.1.13.

NOTE

Applied load means the load at the reaction point (i.e. the weight the scale is measuring), not the total aircraft weight.

c. Scale Resolution. Scale resolution must also be set to indicate appropriate precision.

d. Scale Selection and Usage. Scales shall be properly matched to the anticipated loads on each scale. Scales are properly matched when the anticipated load is greater than 10% and less than 90% of capacity as shown Table 8-1 and the anticipated load exceeds the minimum for the display resolution per Table 8-2.

Table 8-1. Minimum and Maximum Load vs. Scale Capacity

Scale Capacity (lbs.)	Minimum Load (lbs.)	Maximum Load (lbs.)
10	1	9
100	10	90
1,000	100	900
2,500	250	2,250
5,000	500	4,500
10,000	1,000	9,000
25,000	2,500	22,500

Table 8-2. Minimum Load and Display Resolution

Minimum Calibrated Display Resolution (lbs.)	Minimum Allowable Load (lbs.)
0.1	0.1
0.1	1
0.1	5
0.1	100
1	1,000
2	2,000
5	5,000
10	10,000

8.1.10 Unmanned Aircraft System (UAS). Refer to AR 95-1.

8.1.11 Weight and Balance Guidance For Aircraft Modifications.

a. The following instructions are intended to serve as a standard for aircraft modifications with regards to weight and balance management.

b. Typically, A-Kit items are listed exclusively on Chart C, with B-Kits listed on Chart A and posted to the Chart C. Part numbers shall be used when removing or adding components during modification activities.

c. Weights, Arms, and Moments shall be listed to at least one decimal place. It is recommended to use one decimal place, per Figures 8-1, 8-2, and 8-3. Moments are simplified by a constant per MDS (/100, 1000, etc.).

d. Weight and Balance Instructions for Modifications. The items listed in the Figure 8-1, 8-2, and 8-3 charts are for example purposes only. Group new entries IAW Compartment, then Arm in an ascending order.

NOTE

Figure 8-3 Form F is required only for aircraft modifications that contain Form F items.

(1) Weight and Balance Data. In accordance with TM 55-1500-342-23, make entries on DD Form 365-1 Chart A as shown in Figure 8-1, on DD Form 365-3 Chart C as shown in Figure 8-2, and on DD Form 365-4 Form F (when required) as shown in Figure 8-3 and as discussed below:

a. Chart A. Items that are removed are listed in Figure 8-1.

b. Chart A. Items that are installed are listed in Figure 8-1.

c. Chart C. Make entries for items removed/ added as shown in Figure 8-2. Ensure a Header and Footer that reflect the MWO are added to the Chart C.

d. Form F. Make entries for items added as required on DD Form 365-4 Weight and Balance Clearance Form F as shown in Figure 8-3.

8.1.12 Contact Information. For weight and balance technical support, contact the POCs listed below.

DIR, CCDC AvMC
ATTN: (POCs Office Symbol, Contact Name, See (a)-(g) below)
4488 Martin Road
Redstone Arsenal, AL 35898-5000

a. AH-64: FCDD-AMR-AD,
Email: usarmy.redstone.devcom-avmc.mbx.amr-ad-tts@army.mil
CC: usarmy.redstone.devcom-avmc.mbx.amr-sa-tts@army.mil

b. UH-60: FCDD-AMR-AU,
Email: usarmy.redstone.devcom-avmc.mbx.amr-au-tts@army.mil
CC: usarmy.redstone.devcom-avmc.mbx.amr-sa-tts@army.mil

c. CH-47: FCDD-AMR-AB,
Email: usarmy.redstone.devcom-avmc.mbx.amr-ae-ab-tts@army.mil
CC: usarmy.redstone.devcom-avmc.mbx.amr-sa-tts@army.mil

d. Fixed Wing: FCDD-AMR-AB,
Email: usarmy.redstone.devcom-avmc.mbx.amr-ab-tts@army.mil
CC: usarmy.redstone.devcom-avmc.mbx.amr-sa-tts@army.mil

e. MH-60M, MH-47G: FCDD-AMR-AT,
Email: usarmy.redstone.devcom-avmc.mbx.amr-at-tts@army.mil
CC: usarmy.redstone.devcom-avmc.mbx.amr-sa-tts@army.mil

f. Unmanned Aircraft Systems: FCDD- AMR-V,
Email: usarmy.redstone.devcom-avmc.mbx.amr-v-tts@army.mil
CC: usarmy.redstone.devcom-avmc.mbx.amr-sa-tts@army.mil

8.1.13 Corrections to This Manual. Submit DA Form 2028.

8.1.14 Weight and Balance Software. This technical manual does not provide authorization for any specific weight and balance software, to include AWBS.

8.1.15 Distribution of AWBS. AWBS may be obtained via the Joint Technical Data Integration (JTDI) website https://jtdi.mil under the AWBS Tab's software link.

a. Central Server. N/A.

Chart A
(Items that are removed are listed below)

ITEM NO.	PART NUMBER	ITEM DESCRIPTION	WEIGHT	ARM	MOM/1000
B-XXX	12345-A	RADIO, FM #1	2.3	233.0	0.5
F-XXX	ABC-123	SIGNAL CONDITIONER, LH	3.5	515.0	1.8
F-XXX	ABC-123	SIGNAL CONDITIONER, RH	3.5	515.0	1.8

Chart A
(Items that are installed are lested below)

ITEM NO.	PART NUMBER	ITEM DESCRIPTION	WEIGHT	ARM	MOM/1000
B-XXX	5678-B	RADIO, MULTIBAND	1.6	225.0	0.4
F-XXX	129-S	MULTIBAND SIGNAL COND., LH	3.5	496.4	1.7
F-XXX	129-S	MULTIBAND SIGNAL COND., RH	3.5	496.4	1.7
H-XXX	CH 5678	ANTENNA	1.5	50.3	0.1

Figure 8-1. Chart A Aircraft Modification Example

Chart C
Make entries for items removed/added as shown below.
Ensure a Header and Footer that refl ect the MWO are added to the Chart C.

ACTION	ITEM NO.	ITEM DESCRIPTION	WEIGHT	ARM	MOM/1000
Header		Beginning of MWO 49-1979-391 Multiband Radio			
Out	B-XXX	RADIO, FM #1	2.3	233.0	0.5
Out	F-XXX	SIGNAL CONDITIONER, LH	3.5	515.0	1.8
Out	F-XXX	SIGNAL CONDITIONER, RH	3.5	515.0	1.8
Out		Wiring and Associated Hardware	0.8	179.0	0.1
In		Wiring with Hardware	10.4	209.6	2.2
In	B-XXX	RADIO, MULTIBAND	1.6	225.0	0.4
In	F-XXX	MULTIBAND SIGNAL COND., LH	3.5	496.4	1.7
In	F-XXX	MULTIBAND SIGNAL COND., RH	3.5	496.4	1.7
In	H-XXX	ANTENNA	1.5	50.3	0.1
Header		End of MWO 49-1979-391 Multiband Radio			

Figure 8-2. Chart C Aircraft Modification Example

Form F
Make entries for items added as required on DD Form 365-4
Weight and Balance Clearance Form F.

ITEM DESCRIPTION	WEIGHT	ARM	MOM/1000
50 Cal Machine Gun Model AS-678	143.8	102.6	14.8
50 Cal Gun Mount	26.4	102.6	2.7
50 Cal Gun Control Harness	3.5	102.6	0.4
Fuel – Main Tanks	3750	317.0	1190.0
Fluids - Water Ballast	100.0	330.0	33.0

Figure 8-3. Form F Aircraft Modification Example

8.2 US NAVY / US MARINE CORPS REQUIREMENTS

NOTE

Use of AWBS is mandatory unless OPSEC precludes it. See paragraph 8.2.14.

8.2.1 Related References. Weight and balance personnel shall be familiar with the following related technical manuals (supplementary data to this manual) and other related documents:

a. Weight and Balance Handbook. A Weight and Balance Handbook shall be maintained on all active aircraft. Refer to paragraph 8.2.2c for requirements.

b. Chart A. Basic Weight Checklist Record for assigned aircraft model(s).

c. Chart E. Loading Data for assigned aircraft model(s).

d. Naval Aviation Maintenance Program, COMNAVAIRFORINST 4790.2 Series. The Weight and Balance section, Chapter 10, contains top-level guidance and direction regarding field weight and balance control for USN/USMC aircraft.

e. NATOPS General Flight and Operating Instructions, CNAF M-3710.7 Series. Chapter 4 contains direction regarding weight and balance clearance for flight.

f. The NATOPS Flight Manual(s) for Assigned Aircraft Model(s). NATOPS Flight Manuals contain weight and balance (center of gravity) operating limitations for specific aircraft models.

g. The NATIP Flight Manual(s) for Assigned Aircraft Model(s). NATIP Flight Manuals represent the primary reference for technical information required for safe and effective tactical employment, including safety-of-flight limitations and restrictions for specific aircraft models. NATIP documents the loading arrangements and limitations approved for permanent flight clearance.

h. Cargo Loading Manual. The cargo loading manual contains the description of the individual type aircraft cargo capabilities, provisions, systems and features for carrying cargo and troops. This document can also cover cargo type descriptions, loading instructions and procedures, cargo loading equipment operation and stowage, instructions for cargo load-out aircraft weight and center of gravity planning and calculations, cargo tie down calculations, and passenger/patient/troop accommodations installation, operation and removal procedures. This is essentially the “How to load the aircraft” manual.

i. NAVAIRSYSCOM Technical Directives System, NAVAIR 00-25-300. The Weight and Balance sections of the manual that describes the Technical Directives System.

j. NAVAIRSYSCOM Technical Library Management Program, NAVAIR 00-25-100. Contains information on technical manual (Aircraft Weight and Balance Handbook) controls.

8.2.2. Weight and Balance Control. Operational aircraft weight and balance control shall be accomplished in accordance with COMNAVAIRFORINST 4790.2 series (the Naval Aviation Maintenance Program (NAMP)), the specific aircraft NATOPS Flight Manuals, this manual, CNAF M-3710.7 series, and the specific aircraft Chart E - Loading Data.

a. In case of conflicting requirements, procedures, aircraft limits (weight and CG), authorized loadings, and/ or instructions, COMNAVAIRFORINST 4790.2 series and the aircraft NATOPS/NATIP manuals shall take precedence over this manual and the specific aircraft Chart E pending mandatory resolution of the conflict from NAVAIRSYSCOM Mass Properties.

b. In the case of conflicting weight and balance loading data, the aircraft specific Chart E shall take precedence over the aircraft NATOPS/NATIP. Inclusion of weight and moment data in Chart E does not authorize loading arrangements. Check specific aircraft Chart C, Chart E and Form F for current weight and balance information for that aircraft. Weight and balance data in the aircraft NATOPS/NATIP (i.e. aircraft weights, stores weights, etc.) is provided for guidance only.

c. Weight and Balance Handbook. The Weight and Balance Handbook is the primary tool utilized in maintaining weight and balance control for aircraft. The weight and balance handbooks for individual aircraft shall be maintained in accordance with the requirements of this manual.

(1) The contents of an Aircraft Weight and Balance Handbook include the following six elements. Each section should be separated by a divider (if in hardcopy):

(a) Record of Weight and Balance Personnel.

(b) Chart A.

(c) Forms B.

(d) Chart C.

(e) Chart E.

(f) Forms F.

(2) The weight and balance handbook shall take the highest security classification of the data contained therein.

NOTE

AWBS aircraft files contain four of the six elements comprising a complete handbook: Personnel Record, ChartA, Form(s) B and Chart C. Forms F are created by each operational user or unit and are not part of the AWBS aircraft file. Chart E is a separate file from the AWBS aircraft file and is common for the TMS.

TMS that use AWBS to maintain Weight and Balance Handbooks are not required to have a hard copy of the Handbook.

(3) Form Availability:

(a) The following may be obtained from the Navy Data Distribution System (NDDS) at https://ndds.navair.navy.mil or by contacting NAVAIRSYSCOM Mass Properties.

1 TMS specific Chart A for delivery aircraft by lot, re-baselined configuration or major upgrade.

2 TMS specific Chart E.

3 AWBS Auto Limits File(s).

(b) The Joint Technical Data Interface website contains specific TMS data (including some weight and balance applications) for the C-130, MV-22 and H-60 at https://www.jtdi.mil.

(c) All required USN/USMC weight and balance technical data required for program support may be requested from NAVAIRSYSCOM Mass Properties.

8.2.3 Responsibilities.

a. NAVAIRSYSCOM Mass Properties Responsibilities. NAVAIRSYSCOM shall maintain overall responsibility for establishing the requirements, processes, procedures, and forms format for USN/USMC aircraft weight and balance control. NAVAIRSYSCOM Mass Properties is the office of primary responsibility for the following duties:

(1) Establishing technical content and format of the USN/USMC service specific requirements of this manual and coordination with other services regarding general sections of this manual.

(2) Approval/review for technical content and format of Charts A and E for individual aircraft models.

(3) Make available TMS specific Chart A for delivery lot aircraft and for major upgrades or re-baselined configurations as warranted.

(4) Make available current Chart E for all active aircraft.

(5) Create Auto Limits files when necessary and make them available for operational use.

(6) Act as the USN/USMC Technical POC for the Automated Weight and Balance System (AWBS) software.

(7) Determination and specification of USN/ USMC aircraft weight and balance classifications.

(8) Provide specialized weight and balance engineering support to test, maintenance, and operating commands.

(9) Coordinate and recommend changes to the weight and balance requirements of COMNAVAIRFORINST 4790.2 series, CNAF M-3710.7 series, and NAVAIR 00-25-300 instructions.

(10) Coordinate and recommend changes to weight and balance training course content maintained by the Center for Naval Aviation Technical Training (CNATT).

(11) Coordinate and recommend procedures and/or equipment required for compliance with various requirements of the weight and balance control system.

(12) Prepare, obtain and disseminate aircraft weight and balance data that operational Commands require to comply with USN/USMC aircraft weight and balance control system requirements.

(13) Establish weighing intervals for aircraft.

(14) Technical assessment and approval of automated Form F generators.

(15) Determine the need to weigh an aircraft as a result of a major modification. See 8.2.8b(5).

(16) Qualification of Personnel Assigned Responsibility as Lead Weighing Official. NAVAIRSYSCOM Mass Properties shall verify that the personnel assigned the responsibility for weighing aircraft (acting as a Lead Weighing Official) meet the qualification requirements of this document. Mass Properties shall maintain a record of qualified personnel and shall produce and disseminate a Letter of Qualification for Lead Weighing Official personnel meeting the requirements.

b. Training Group Responsibilities. The Center for Naval Aviation Technical Training (CNATT) shall prepare and provide introductory weight and balance training required for Command compliance with the USN/USMC aircraft weight and balance control system. CNATT shall coordinate course content and special training procedures with NAVAIR Mass Properties to ensure content is appropriate and meets applicable standards. NAVAIRSYSCOM Mass Properties must approve all course revisions prior to implementation.

c. Depot Level Maintenance Responsibilities. Fleet Readiness Centers (FRCs) shall weigh aircraft and update individual aircraft Weight and Balance Handbooks in accordance with the requirements of COMNAVAIRFORINST 4790.2 series and this manual. The FRCs shall ensure that a dedicated staff of qualified personnel are available to accomplish the required tasks and shall designate the Lead Weight and Balance Specialist responsible.

d. Type Commander / Aircraft Controlling Custodians/ Functional Wing Responsibilities.

(1) Shall ensure that reporting custodians and FRCs meet the requirements of COMNAVAIRFORINST 4790.2 series, CNAF M-3710.7 series and this manual.

(2) Shall perform periodic Aviation Maintenance Inspections (AMI) to evaluate the activities compliance with Weight and Balance requirements of COMNAVAIRFORINST 4790.2 series, CNAF M-3710.7 series, NAVAIR 00-25-300, NAVAIR 00-25-100, and this manual.

e. Aircraft Reporting Custodian Responsibilities.

(1) Per the NAMP, Aircraft Reporting Custodians are those Navy, Marine Corps and commercial contractors assigned custody of aircraft for purposes of flight, repair/rework or storage.

(2) For weight and balance purposes, when an aircraft is in the physical custody of an activity, that activity is responsible for the maintenance of all weight and balance records. When an aircraft is inducted into off-site rework facility or is on loan to another activity, the weight and balance records shall accompany the aircraft and be maintained by the physical custodian.

(3) The Reporting Custodian shall designate a Weight and Balance Officer for the activity and any additional qualified Weight and Balance Personnel (Weight and Balance Technicians), in accordance with COMNAVAIRFORINST 4790.2 series. If COMNAVFORINST 4790.2 does not specify such designations for rework facilities or other activities, those activities shall designate qualified Weight and Balance personnel.

(a) Maintenance Material Control Officer (MMCO) shall be designated as the Weight and Balance Officer for the activity.

(b) The Commanding Officer of commands that employ temporary detachments away from the squadron, has the authority to, but is not required to, designate a Weight and Balance Officer for each detachment if not the MMCO.

(c) These individuals must meet the qualifications for designation in accordance with the COMNAVAIRFORINST 4790.2 series.

(d) The Monthly Maintenance Plan (MMP) shall list designated individuals.

(e) Weight and Balance Technicians are personnel maintaining weight and balance records under the authority of the Weight and Balance Officer as designated in the MMP. This designation shall indicate their level of authority, based on their individual qualifications.

(4) Reporting Custodians shall ensure that weight and balance control system requirements and procedures of this manual and related technical documentation are complied with in accordance with the management procedures of COMNAVAIRFORINST 4790.2 series and CNAF M-3710.7 series. Weight and balance control system requirements and procedures shall include, but are not necessarily limited to ensuring:

(a) Weight and balance handbooks for all assigned aircraft, including newly received aircraft, are complete, current, and maintained in the correct format.

(b) Procedures are in place to ensure completion of weight and balance flight clearance per CNAF M-3710.7 series, the TMS specific loading manual, and this manual.

(c) Weight and balance impacts due to changes incorporated shall be properly recorded in the weight and balance handbooks of each aircraft affected by the change. Such changes include Technical Directives, Interim Flight Clearances, repairs, or other modifications.

(d) Concerns regarding accuracy of weight and balance data for any assigned aircraft are resolved satisfactorily, for example, by having aircraft weighed by an authorized weighing facility or field team.

(e) Ensure that Aircraft Battle Damage Repair (ABDR) actions do not result in unacceptable impacts on aircraft weight and balance.

NOTE

The MMCO or Lead Weight and Balance Specialist have the discretion to determine what is unacceptable.

(f) Configuration of aircraft with proper amounts of ballast as required to maintain the aircraft within the prescribed CG limits throughout its flight. The addition of ballast shall not compromise structural integrity of the aircraft and therefore any new ballast shall be approved by NAVAIRSYSCOM Mass Properties before it can be installed. Whenever ballast is required to balance an aircraft after the removal of equipment, placement of temporary ballast in the vacant equipment mounts up to the weight of the removed equipment is acceptable.

(g) When necessary, commands may impose more stringent requirements for weight and balance control through command supplements to applicable service manuals and instructions.

(h) The reporting custodian may request permission, via proper chain of command, to implement procedures to simplify aircraft weight and balance maintenance that do not conflict with this manual, the aircraft specific loading manual, or other applicable directives. Permission is required from NAVAIRSYSCOM Mass Properties for alternate procedures.

f. Commercial Maintenance Responsibilities. Commercial activities involved in the weight and balance control of USN/USMC aircraft shall comply with requirements in paragraphs 8.2.3c, 8.2.3e, and 8.2.4 as applicable.

8.2.4 Personnel Qualification Requirements.

a. Original Equipment Manufacturer (OEM) employees are qualified to weigh their own products and do not require additional NAVAIR qualification.

b. Military and government personnel, both civilian and contractor, must be qualified as shown in Table 8-1.

(1) When requesting a Letter of Qualification for a Lead Weighing Official from NAVAIRSYSCOM Mass Properties, provide evidence of course completion and Forms B as required.

(2) Exceptions to these requirements and approval of equivalent training that fulfills the intent of the qualification requirements must be obtained from NAVAIRSYSCOM Mass Properties.

(3) Personnel qualified to weigh a Type-Model by another Department of Defense service are qualified to weigh the same USN/USMC Type-Model.

NOTE

As an example, USAF personnel qualified by the USAF to weigh an F-35A are qualified to weigh the F-35B and/or F-35C.

c. NAVAIRSYSCOM Mass Properties shall verify that civilian contractor personnel have met the intent of the qualifications of this section.

(1) When requesting a Letter of Qualification for civilian contractor personnel from NAVAIRSYSCOM Mass Properties, provide the following:

(a) A statement specifically requesting which function(s) the person is to be qualified (e.g. Weight and Balance Technician.

(b) A statement that the person has met internal company training requirements for the function(s) requested.

(c) Certificates from courses required to meet internal company training requirements.

(d) If applicable, Forms B or equivalent for the TMS(s) for which the civilian contractor is seeking qualification.

d. Maintaining Qualification.

(1) Weight and Balance Officers, Weight and Balance Technicians, and Aircrew personnel completing DD365-4 Clearance Forms F or equivalent maintain their qualifications for 5 years after assignments out of the above responsibilities. After 5 years, these personnel must re-qualify per requirements in Table 8-1.

(2) Lead Weighing Official and Personnel Assigned Responsibility for Weighing Aircraft. In order for personnel assigned responsibility for weighing aircraft to maintain their qualification, they must weigh one aircraft of each authorized TMS every two years. Personnel must re-qualify per requirements in Table 8-1 if they fail to meet this requirement within the two-year period. Weighing personnel should maintain records of aircraft weighed to justify maintaining their qualification.

(3) Qualification letters written under previous revisions of the Joint Technical Manual continue to apply under later revisions of the JTM. There is no need for a new letter simply because the JTM date changes.

8.2.5 Retention and Disposition of Records / Charts / Forms. Weight and balance records for aircraft stricken from the Navy inventory are disposed of in accordance with the requirements of COMNAVAIRFORINST 4790.2 series with all other aircraft logs and records.

NOTE

Refer to SECNAV M-5210.1 series for procedures for transferring records to the Washington National Records Center. SECNAVINST 5510.30 series provides guidance for shipping classified information to the Washington National Records Center.

a. Records / Charts / Forms Retention.

(1) AWBS Personnel Record or DD 365 equivalent: permanent record.

(2) AWBS Chart A or DD 365-1 equivalent: Chart A shall be retained to trace Basic Weight/Moment/CG to the last aircraft weighing. Before applying an AWBS Master Chart A, the current Chart A, with all inventory histories, must be printed and retained until the aircraft is weighed again. Chart A history may be disposed of after the next weighing. After an AWBS Master Chart A has been applied, an inventory shall be completed to verify the in/out status of Chart A items.

(3) AWBS Form B or DD 365-2 equivalent: permanent record.

(4) AWBS Chart C or DD 365-3 equivalent: permanent record.

(5) Chart E: maintain the current version authorized by NAVAIRSYSCOM Mass Properties. If updated between weighings, retain the superseded copies in the superseded section until the next aircraft weighing. It may be disposed of after the next weighing.

(6) AWBS Forms F, authorized electronic equivalents or DD 365-4 equivalent:

(a) One-time Use Forms F: retain for three (3) months in accordance with CNAF M-3710.7 series. Refer to paragraph 8.2.7a(2).

(b) Standardized Loading (formerly CANNED) Forms F: retain for three (3) months after superseded. Refer to paragraph 8.2.7a (3).

b. Records/Charts/Forms Retention - Inactive/Stricken Aircraft.

(1) Using the AWBS client application, transfer the aircraft record via Central Server to “AMARG, DMAFB, AZ” as the Receiving Home Station and relieve the current technician.

(2) Delete aircraft record from the operational unit’s AWBS database.

8.2.6 Aircraft Classifications.

a. For weight and balance purposes, USN/USMC aircraft are divided into three classifications; Class 1A, Class 1B, and Class 2.

b. Class 1A aircraft are those aircraft that do not require a Weight & Balance Handbook, and do not have to comply with the NAVAIR 01-1B-50. If required by the Class 1A aircraft OEM flight manual, Weight & Balance control is performed in accordance with the OEM-supplied Weight & Balance documentation and tools. NAVAIRSYSCOM Mass Properties has no insight into or oversight of Class 1A OEM-supplied

Table 8-3. USN / USMC Qualification Requirements

Establishing Qualification Requirements		Weight and Balance Officer	Weight and Balance Technician	Lead Weighing Official	Lead Weight and Balance Specialist at FRC
Qualify for Designation	Training courses required by COMNAVFORINST 4790.2, or	Complete One			
	Commercial equivalent				
Maintaining Weight and Balance Records	Aircraft Weight and Balance Course, C-516-0001, or		Complete One		
	Equivalent required by COMNAVFORINST 4790.3, or				
	Course Number 088980ILT01 offered by Lockheed Martin, or				
	Aircraft Weight and Balance Course offered by General Electrodynamics (GEC), or				
	Commercial equivalent				
Completing Forms F	TMS training syllabus, or		Complete One		
	Aircraft Weight and Balance course, C-516-0001, or				
	Equivalent required by COMNAVFORINST 4790.2				
Weighing Aircraft	Training Course required by COMNAVFORINST 4790.2, or			Complete One	Complete One
	Aircraft Weight and Balance Course AND AWBS course offered by Society of Allied Weight Engineers (SAWE), or				
	Course Number 088980ILT01 offered by Lockheed Martin, or				
	Intercomp “Aircraft Weight and Balance Training” AND “Automated Weight and Balance Systems (AWBS) Software Training, or				
	Aircraft Weight and Balance Course offered by General Electrodynamics (GEC)				
	Aircraft Weighing Course offered by Society of Allied Weight Engineers (SAWE)			Complete	Complete
	Documented experience weighing at least 20 aircraft of four different TMS within previous year, or			Complete One	
	Six weighings of one TMS within previous year when authority will be limited to that TMS				
	Twelve months actual experience weighing at least sixty aircraft of at least five different TMS over past two years				Complete

Weight & Balance documentation and tools. Any issues or questions on such documentation and tools must be directed to the OEM.

c. Class 1B and Class 2 aircraft must have a W&B Handbook and must comply with the NAVAIR 01-1B-50.

d. Weight and balance classification of USN/ USMC aircraft are shown in Table 8-4. All models of the same series take on the same weight and balance classification unless specifically designated otherwise. For aircraft not specifically listed in Table 8-4, assume a Class 1B/Class 2 designation.

e. All series of the models listed in Table 8-4 shall be in the class designated, unless otherwise designated.

8.2.7 Form F.

a. Form F Procedures.

(1) All Forms F shall be completed in accordance with Chapter 4 of this manual.

(2) One-time Use Forms F are prepared for single- instance use to reflect a specific loading configuration applicable to a specific serial number aircraft. They are generally used when the Command does not utilize a standardized loading approach or when an aircraft is loaded in a manner not represented by a standard loading. Superseded or canceled standard loadings shall be retained on file for 90 days.

(3) Standardized loadings (formerly CANNED Forms F) are prepared for repeated use to reflect a loading configuration that could apply to more than one aircraft of a given TMS. If the Basic Weight and/ or Basic Moment of any of three baseline aircraft (discussed below) changes, all existing Forms F based on standard loadings using those aircraft must be replaced. One copy shall be inserted into the Handbook of the aircraft that changed and a second copy shall be made available to the aircrew during briefing. The second copy may be inserted into the Aircraft Discrepancy Book (ADB), if utilized, or elsewhere so long as it is readily available to the aircrew. Standardized loadings shall be checked every 180 days for accuracy. New Forms shall be prepared whenever Chart C Basic Weight and/ or moment change for any of the three baseline aircraft. If no changes are required, the Form F may be re-dated or a letter issued certifying it is still current. The letter shall list the serial number aircraft and Forms that were reviewed.

b. Standardized Loading Procedures. At the option of the Aircraft Reporting Custodian, standard loadings for a given TMS may be utilized with the following procedures to accomplish weight and balance flight clearance:

(1) Examine the weight and balance handbooks of all aircraft of the TMS in the Command to determine which three serial number aircraft meet these criteria:

(a) Most-forward Basic CG,

(b) Most-aft Basic CG,

(c) Heaviest Basic Weight.

(2) These three serial number aircraft may be used to establish a baseline for determining a standard loading arrangement that would enable all aircraft of the TMS to remain within limits.

(3) Once this loading arrangement has been verified to remain within limits for all three baseline aircraft, the standard loading can be used to create Forms F for other aircraft of the same TMS. Standard loading Forms F must be signed per paragraph 8.2.7d and distributed per paragraph 8.2.7a(3).

(4) Auto Limit files simplify and more accurately determine forward and aft CG limits when generating Forms F using AWBS. These files, unique to each TMS, automatically determine the weight and CG limits at various conditions of the weight buildup. Depending on the TMS, mission scenario, and loading conditions, there may be more than one Auto Limits file to apply. Use of Auto Limits files is strongly encouraged for TMS that do not have constant forward and aft CG limits and do not have a dedicated Form F generator. Aircrew responsible for completing Forms F are responsible to ensuring that the proper Auto Limits file is used depending on mission scenario and loading conditions.

(5) If an AWBS Form F has an Auto Limits envelope selected, the weight and CG limits will be updated as each aircraft's Basic Weight and Basic Moment are combined with the standard loading.

(6) If an Auto Limits envelope is NOT selected, the weight and CG Limits will NOT be updated as each aircraft's Basic Weight and Basic Moment are combined with the standard loading. In this case, if the operating limits vary based on Gross Weight, the most restrictive limits MUST be utilized.

(7) For purposes of weight and balance flight clearance, the standard loading Form F shall be referenced.

(8) Standard loadings are sensitive to changes incorporated into any of the three baseline aircraft such as incorporation of TDs, engine and equipment changes, modifications and repairs. Therefore, weight and balance handbooks for the baseline aircraft shall be monitored closely with regard to standard loadings. Incorporated changes that affect Basic Weight and Moment in any of the three baseline aircraft require re-checking of standard loadings to ensure operating limits are still maintained. Replace Forms F based on standard loading if the loading was affected due to changes incorporated in the baseline aircraft.

c. Form F Gear Up, Gear Down CG Limits and Gear Up Moment Change (GUMC) Discussion.

(1) In AWBS, fixed-wing and rotary-wing aircraft with retractable landing gear shall set the "CHECK

Table 8-4. USN / USMC Aircraft Classification Assignments

AIRCRAFT TYPE	Class 1A	Class 1B and Class 2
FIGHTER/ATTACK		AV-8, F-5, F-18, F/A-16 F-35
PATROL / SURVEILLANCE		P-3, P-8
ELECTRONIC		E-2, E-6, EA-18, EP-3
CARGO / TRANSPORT	UC-12, C-35, C-20G, C-37	C-12, RC-12, C-130, C-144, C-2, , C-26, , C-38, C-40, C-9
HELICOPTER		H-1, H-3, H-60, H-53
VIP HELO TRANSPORT		VH-3, VH-60, VH-92
TRAINER		U-1, O-2, OH-58, T-2, T-34, T-38, T-39, T-44, T-45, T-6, TAV-8, TC-12, TH-57, TH-6, TH-73, U-6, UH-72, UV-18, X-26
SPECIAL / UAV / OTHER	RQ-21, RQ-23, CQ-24, RQ-26	CMV-22, MQ-4, MQ-8, MQ-9, MV-22, RQ-4

LIMITS" to "VERIFY" for "TAKEOFF LIMITS, Gear Down CG", "TAKEOFF LIMITS, Gear Up CG", "LANDING LIMITS, Gear Up CG", and "LANDING LIMITS, Gear Down CG" unless otherwise specified in the Chart E.

(2) Aircraft with retractable landing gear need to consider the moment impact due to gear retraction. The Gear up Moment Change (GUMC) quantifies this moment. The aircraft's GUMC shall be listed in Chart E, if applicable, and is entered into the Aircraft Description section in AWBS for each BUNO. The value entered must be in simplified form taking into account the moment simplifier for the TMS. Aircraft with fixed landing gear have a GUMC of zero.

d. Form F Signatures.

(1) Computed By: The signature of the individual completing the Form F. Must be qualified per paragraph 8.2.4a.

(2) Weight and Balance Authority: The signature of the Weight and Balance Officer or qualified member of the aircrew when on detachment. At the completion of the flight, all one-time use Forms F shall be delivered to the Weight and Balance Officer for review and verification screening. After screening, the Weight and Balance Office shall sign in the Weight and Balance Authority block or initial next to an existing signature and retain the form on file for 3 months in accordance with CNAF M-3710.7 series.

NOTE

Certification of Safe for Flight for One Time Use Forms F for weight and balance purposes does not require the Weight and Balance Officer's signature prior to takeoff, as he/she may not be present at that time.

(a) When selected, AWBS enables Weight and Balance personnel to digitally sign Forms F using the PKI certificate on the user's CAC. For clarification purposes, this is not a full digital CAC signature at this time. Use of AWBS electronic signature stamp is authorized for all USN/USMC aviation activities. Selection of any one, all three, or any combination of signature blocks is possible but only one PKI certificate will apply.

NOTE

AWBS electronic signature stamps are not mandatory, but they are authorized for use. Use of PDF copies of Forms F with digital CAC signature, as well as pen and ink stamp all remain as viable options.

(3) Pilot. The signature of the Pilot shall appear on all One-time Use Forms F. The pilot's signature is not required when using a standardized Form F. Enter "As Assigned" in this case.

e. Authorized Substitutions for DD Form 365-4. NAVAIRSYSCOM Mass Properties may authorize manual or electronic substitutions for DD Form 365-4 Form F.

8.2.8 Aircraft Weighing Requirements.

NOTE

It is acceptable to base the weight and CG on the Form B and Chart C of new production aircraft using the weight and CG of another aircraft in that same production lot.

a. When using AWBS, Chart A items shall not be listed in COLUMN I or COLUMN II with the exception of Trapped and Unusable Fuel if listed as Chart A items. The IN AIRCRAFT status of Chart A items in the inventory shall be consistent with the condition at weighing when using AWBS. If Chart A items are added or removed subsequent to weighing, AWBS enables such changes to be made easily.

NOTE

The listing of Chart A items in COLUMN II on Form B combined with Chart A inventory status as 'IN' leads to uncertainty.

b. Aircraft shall be weighed when any of the following conditions exist:

(1) As specified in technical directives or technical orders.

(2) When weighing requirements are specified in the applicable Chart E or other document.

(3) Before returning to flight after completion of standard rework processes (e.g. Standard Depot Level Maintenance (SDLM), Enhanced Phase Maintenance (EPM), Selected Planned Maintenance Interval (PMI), etc.) that includes but is not limited to scheduled/unscheduled strip and/or paint events.

(4) When major modifications or repairs are made that meet the following guidelines:

(5) NAVAIRSYSCOM Mass Properties shall determine when an aircraft has undergone a "major modification or repair". As a guideline, a major modification or repair is one that affects 2% of Basic Weight or 500 lb., whichever is less, or changes the Basic CG by 0.5% MAC for fixed-wing or 0.5 inches for rotary-wing. Determination of affected weight is based on the weight sum of items removed (excluding Chart A items) plus the weight sum of items added (excluding Chart A items). Affected weight is not the resultant change or difference between the two sums. All "major modifications or repairs" shall require the vehicle to be weighed prior to return to flight. For technical directives, this requirement shall be noted in the TD and verified during the Validation and Verification process prior to the TD being issued.

NOTE

Overhaul or major airframe repairs include, but are not limited to the replacement of major structural members such as spars, wings, tail booms, etc. Chart A items are excluded, as are aircraft engines, when determining weight affected.

(6) When aircraft modifications or repairs are accomplished and calculated or actual weight and moment data are not available.

(7) When the calculated weight and balance data are suspected to be in error.

(8) When unsatisfactory flight characteristics are reported that cannot be attributed to improper loading, an error in weigh and balance data, or any other identifiable cause.

(9) When an aircraft is in a depot facility or other authorized and capable weighing facility for any reason, and has not been weighed in five (5) years, (i.e. the most recent "as-weighed" Basic Weight entry in the Chart C is more than five (5) years ago).

(a) If an aircraft was last weighed more than five years ago and it is managed by a formal maintenance plan that requires periodic weighing (e.g. PMI within an Integrated Maintenance Plan (IMP)), then the aircraft should be weighed according to that plan. If the aircraft is not managed by a plan that requires periodic weighing, then the aircraft should be weighed at the next opportunity when it is in an authorized and capable facility.

(10) Whenever inactive aircraft become active. (Reference Chapter 3, paragraph 3.7).

(11) When the weight and balance handbook cannot be replaced using historical records.

c. Weighing Intervals. See paragraph 8.2.8b(9) and 8.2.8b(9)(a).

8.2.9 Transfer / Acceptance Inventory.

a. A complete physical/visual inventory of Chart A items shall be performed whenever an activity

accepts an aircraft from another custodian. This includes aircraft on temporary loan or off-site rework/mod.

NOTE

If there is no change in custodian, i.e. FRC rework that will not require a weighing, an inventory does not have to be performed during this evolution.

Some aircraft (e.g. F-35) have provision to conduct an electronic inventory. This is an acceptable alternative to performing a visual inventory of compartments.

b. This Chart A inventory is not to be confused with the Aircraft Inventory Record inventory performed for parts tracking/accountability and the Chart A inventory should not be performed until the aircraft has been configured for operations.

c. In addition, a screening of all technical directives that have been incorporated since the last weighing shall be performed. If a TD has been incorporated since the last weighing, verify the Chart A and Chart C entries have been made correctly, if applicable.

d. Technical directives incorporated since the last weighing may be obtained by identifying the date of the last weighing and comparing it to the Aircraft's Logbook, Technical Directives Section on CNAF FORM 4790/24A, Technical Directives Form and the DECKPLATE Incorporation Listing for Equipment Report LIST 04 Technical Directives Requirements.

e. The activity giving up an aircraft shall use the "Transfer Aircraft to Another Unit" feature using the Central Server function in AWBS. This requires identifying the receiving unit in order to upload to the server.

f. If the Central Server is not used, the activity giving up an aircraft shall export the aircraft record to a file, copy the file to recordable media and send the media to the receiving unit.

g. The receiving unit shall download the aircraft from the Central Server or copy the aircraft file from recordable media and import the aircraft record into an AWBS database. After the AWBS file has been imported into the database of the receiving organization, verify the correct limits are set in the Form F Generator or on all existing Forms F applicable for that aircraft.

8.2.10 Scales.

a. Scale Calibration. All scales and load cells utilized to weigh USN/USMC aircraft by organic USN/USMC activities shall be calibrated per the requirements set by Naval Surface Warfare Center (NSWC) Corona and published in NA17-35MTL-1 Metrology Requirements List. Scales used by commercial activities shall be calibrated on a cycle in accordance with the commercial activity engineering, commercial activity metrology, and scale manufacturer policies and recommendations.

b. Scale Accuracy. All scales utilized to weigh USN/USMC aircraft shall be calibrated to 0.1 percent of the applied load between 10% and 90% of capacity.

NOTE

Applied load means the load at the reaction point (i.e. the weight the scale is measuring), not the total aircraft weight.

c. Scale Resolution. Not only must the scale be calibrated to be accurate but the scale resolution must also be set to indicate accurate precision.

d. Scale Selection and Usage.

(1) All USN/USMC aircraft that have wheel-type gear shall be weighed on stationary pit-type platform scales (reference Chapter 5, paragraph 5.2.1) or portable platform aircraft scales (reference Chapter 5, paragraph 5.2.2) unless prior approval from NAVAIRSYSCOM Mass Properties is obtained to use electronic weigh kits (load cells) (reference Chapter 5, paragraph 5.2.3). Aircraft with skid-type landing gear can only be weighed using load cells and therefore do not require NAVAIRSYSCOM Mass Properties approval. Chart E weighing procedures that include using load cells constitute NAVAIRSYSCOM Mass Properties approval to use load cells.

Table 8-5. Minimum and Maximum Load vs. Scale Capacity

Scale Capacity (lbs.)	Minimum Load (lbs.)	Maximum Load (lbs.)
2,500	250	2,250
5,000	500	4,500
15,000	1,500	13,500
30,000	3,000	27,000
60,000	6,000	54,000

Table 8-6. Minimum Load and Display Resolution

Calibrated Display Resolution (lbs.)	Minimum Allowable Load (lbs.)
0.1	100
1	1,000
2	2,000
5	5,000
10	10,000

(2) Scales shall be properly matched to the anticipated loads on each scale. Scales are properly matched when the anticipated load is greater than 10% and less than 90% of capacity as shown Table 8-5 and the anticipated load exceeds the minimum for the display resolution per Table 8-6.

NOTE

60,000-lb capacity scales have excessive capacity for most Naval Aviation aircraft.

8.2.11 Weight and Balance Guidance for Aircraft Modifications.

a. NAVAIR 00-25-300, Naval Air Systems Command Technical Directive System Management and Procedures Manual is intended to furnish the Naval Aviation Enterprise (NAE) policy, processes, and guidance for Development and Management for Technical Directives/ Aircraft Modifications.

b. NAVAIR 00-25-300 contains specific information on the procedures for updating weight and balance records as a result of technical directives. Weight and Balance personnel shall become familiar with Appendix A for guidance.

c. If the Weight and Balance paragraph of a TD is suspected to be in error, immediately contact the immediate superior in command (i.e. Wing/ MAG/MALS, etc.) for resolution. If unavailable, email NAVAIRSYSCOM Mass Properties for resolution, and submit a TPDR via JDRS at https://jdrs.mil. The category of the TPDR will be dependent on the severity of the finding.

8.2.12 Contact information for NAVAIRSYSCOM Mass Properties:

E-mail: weight&balance@navy.mil
MAILING ADDRESS:
NAVAL AIR SYSTEMS COMMAND
Mass Properties, BLDG 2943 48131 Shaw Road
Patuxent River, MD 20670

8.2.13 Corrections to This Manual. Changes or corrections to this manual are made through normal technical manual change procedures by submitting a Technical Publication Deficiency Report (TPDR) to the Naval Air Technical Data and Engineering Service Command (NATEC) using the Joint Discrepancy Reporting System (JDRS) at https://jdrs.mil/. Corrections to TMS specific Charts A and E shall be directed to NAVAIRSYSCOM Mass Properties using the contact information in paragraph 8.2.12.

8.2.14 AWBS Requirements.

a. The use of AWBS and Central Server is mandatory for all USN/USMC activities unless operational security (OPSEC) requires use of paper or non-AWBS electronic forms or other means. Requests to deviate from AWBS use requires prior approval from NAVAIRSYSCOM Mass Properties.

b. The AWBS client application enables users to transfer, take ownership of, upload/backup and download/ restore aircraft files using the Central Server. The Central Server shall be used as the primary method for backing up and transfer of AWBS files. The address for the USN Central Server is https://awbs.hill.af.mil/CentralUSN. The address for the USMC Central Server is https://awbs.hill.af.mil/CentralUSMC. If OPSEC precludes using the Central Server, local backup of AWBS data to a hard drive, share drive, or external drive is the only method to store and recover data.

c. AWBS users shall back-up aircraft records, and aircraft loadings (Forms F), to a hard drive, share drive, or external drive every 30 days unless the aircraft is at a facility such as an FRC undergoing long term depot maintenance.

NOTE

It is highly recommended that AWBS users back-up aircraft records and aircraft loadings, if applicable, to the Central Server upon completing actions that impact Chart C Basic Weight and center of gravity. An action impacts Chart C if the latest date on the Chart C changes.

d. Users shall back-up aircraft records both immediately prior to and immediately following deployment to preclude data loss and possible shipboard and/or OCONUS connectivity issues.

e. If the AWBS client application prompts the user to back-up their database, users shall perform a secondary back-up of their AWBS database to the hard drive, share drive, or external drive. This is critical for activities that utilize standardized loadings since the AWBS Central Server does not currently allow for back-up of Forms F.

f. In addition, local back-up must also include all other AWBS data (i.e. Master Charts A, Aircraft Modification Files, etc.).

CAUTION

It is strongly recommended that the secondary backup of AWBS data be on either removable storage media or to a network server to prevent the loss of data in the event of computer malfunction or loss.

g. AWBS Form B intervals shall, by default, be set to 0 months. Since most Naval Aviation Enterprise TMS are weighed periodically in accordance with Planned Maintenance Interval (or similar depot level maintenance interval) schedules there is no time-compliance weighing requirement, i.e. every 5 years. Therefore, for these PMI-weighed TMS there is no AWBS Form B interval. The AWBS Form B interval should be set to 60 months for those TMS that are not weighed periodically at PMIs or similar depot level maintenance intervals.

h. AWBS does not completely replace the weight and balance handbook, nor will it replace the need for the user to apply their knowledge of performing aircraft weight and balance. It is simply a tool to perform weight and balance tasks more efficiently and more accurately.

i. If OPSEC requires, it is acceptable for activities to utilize the paper DD Form 365-4 Clearance Form F for one-time use, as required. In these cases, no AWBS deviation authorizations by NAVAIRSYSCOM Mass Properties are required.

j. AWBS software is available to Navy users by submitting a Move-Add-Change (MAC) request to NMCI to obtain it. Periodic AWBS “patches” may be made available through the AWBS website at https://awbs.hill.af.mil/.

k. AWBS software is available to USMC users through MCEN software distribution channels. Periodic AWBS “patches” may be made available through the AWBS website at https://awbs.hill.af.mil/.

l. All AWBS users shall establish and maintain an account for the AWBS website. This will ensure notification of AWBS updates, notification of AWBS Technical Interchange Meetings, access to AWBS issue resolutions, and access to the AWBS Central Server.

m. Users shall either log into the AWBS website or sign into the Central Server on an annual basis. Users can get accounts reactivated by contacting NAVAIRSYSCOM Mass Properties.

n. AWBS users shall update their existing profile on the AWBS website when their information changes (e.g., e-mail address, organizational unit, TMS) rather than initiating a new profile.

8.3 US AIR FORCE REQUIREMENTS

8.3.1 Related References. Weight and balance personnel shall be familiar with the following related technical manuals (supplementary data to this manual) and other related documents:

a. Aircraft -5 Series TO: Sample Basic Weight Checklists and Loading Data.

b. Aircraft -6 Series TO: Scheduled Inspection and Maintenance Requirements.

c. Aircraft -9 Series TO: Cargo Loading Manual.

d. Aircraft -1-2 Series TO: Flight Manual.

e. TO 35B2 Series: Aircraft Handling and Weighing Equipment.

f. TO 00-5-1: AF Technical Order System.

g. AFRIMS: Records Disposition Schedule.

h. AFI 21 Series: Maintenance Management.

i. AFI 11-215: Flight Manuals Program.

j. TO 33K Series: Technical Manual for Scale Calibration.

8.3.2 Weight and Balance Control. Operational aircraft weight and balance control shall be accomplished in accordance with the detailed requirements and instruction of the specific aircraft -5 series TO and the requirements of this manual. In case of conflicting requirements, procedures, or instructions, the aircraft -5 series TO shall take precedence over this manual pending resolution of the conflict.

8.3.3 Weight and Balance Handbooks. An aircraft Weight and Balance Handbook is the continuous record of the weight and balance of a particular aircraft. There are two types of Weight and Balance Handbooks; a primary handbook is required for each aircraft, and an optional supplemental handbook acts as an abbreviated version of the primary handbook. For some aircraft, a completely electronic Weight and Balance Handbook (primary and/or supplemental) may be authorized by the appropriate Command.

a. A Weight and Balance Handbook is required for all active aircraft. Inactive aircraft (flyable temporary storage, static display, ground training, aircraft battle damage repair, etc.) do not require current and up-to-date Weight and Balance Handbooks. If these inactive aircraft become active, the Weight and Balance Handbook will be updated with an actual weighing prior to first flight. If the Weight and Balance Handbook is not available, it will be initiated in accordance with paragraph 8.3.3.f.

NOTE

AWBS acts as an electronic Weight and Balance Handbook when all items are appropriately maintained.

b. Primary Handbooks. A primary Weight and Balance Handbook shall be maintained for each assigned active aircraft by qualified weight and balance personnel. The handbook charts, forms, and, when required, the aircraft -5 series TO, shall be maintained in accordance with requirements and instructions of this manual, TO 00-5-1 and AFRIMS - Record Disposition Schedule.

(1) The contents of the primary Weight and Balance Handbook shall be arranged and maintained in the following order:

(a) Locally developed cover page containing the MDS and Serial Number.

(b) Record of Weight and Balance Personnel (DD Form 365)

(c) Chart A, Basic Weight Checklist Record (DD Form 365-1)

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

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

(f) Chart E, Loading Data. Applicable aircraft -5 series TO, unless there is a supplemental Weight and Balance Handbook or the primary Weight and Balance Handbook is permanently stored in a central location not on board the aircraft

NOTE

If the -5 series TO is in the form of multiple TOs (-5-1 and -5-2), only the Loading Data TO needs to be included.

(g) Form F, Flight Clearance Form (DD Form 365-4), if desired. Form F is advisable to be kept in Weight and Balance Handbook whenever

someone other than the normal Weight and Balance Authority may be completing a Form F for this aircraft.

c. Supplemental Handbooks. Commands that maintain primary Weight and Balance Handbooks in a central location shall assemble and maintain supplemental handbooks for storage on all Class 2 non- fighter aircraft except for Class 2 UAV aircraft. The maintenance of these supplemental handbooks shall be the responsibility of the individual assigned the responsibility for the primary handbook. As a minimum, supplemental handbooks shall include:

(1) A statement identifying the qualified person responsible for maintaining the handbooks, their duty station, office symbol, and phone number. This statement shall also note that changes to the aircraft Basic Weight and/or Moment shall be coordinated with the individual assigned responsibility for handbook maintenance.

(2) A certified copy of the current (last page) Chart C, DD Form 365-3, the AWBS substitute or locally generated form to provide the current aircraft Basic Weight, Basic Moment or Index, and CG location.

(3) The applicable aircraft -5 series TO.

NOTE

If the -5 series TO is in the form of multiple TOs, only the Loading Data TOs need to be included. The Sample Basic Weight Checklist does not have to be included. Electronic TOs may be utilized, unless the unit Weight and Balance Authority requires paper TOs in the supplemental handbooks.

d. Handbook Location. Class 1 aircraft Weight and Balance Handbooks shall be stored in a location as determined by the Command. Class 2 aircraft primary Weight and Balance Handbooks for non-fighter aircraft (See paragraph 3.6) shall be stored on the aircraft when the aircraft is in flight, or as determined by the Command if a supplemental handbook is maintained for storage on the aircraft. Class 2 primary Weight and Balance Handbooks for fighter aircraft shall be stored as determined by the Commands.

e. Handbook Security Classification. Aircraft Weight and Balance Handbooks shall be classified in accordance with the highest security classification of the data contained therein.

f. Handbook Replacement. In the event an aircraft's primary Weight and Balance Handbook or pages becomes lost, is damaged, or for any reason needs to be replaced, the individual assigned responsibility for that aircraft handbook shall assemble a new handbook as follows:

(1) Obtain a new cover page containing the MDS and Serial Number.

(2) Obtain and complete Record of Weight and Balance Personnel, DD Form 365.

(3) Obtain sufficient copies of the Chart A, DD Form 365-1, and use the applicable aircraft -5 series TO to prepare a new Chart A.

(4) Inventory the aircraft.

(5) Obtain the Form B, DD Form 365-2, and weigh the aircraft in accordance with applicable directives, then complete the Form B.

(6) Obtain the Chart C, DD Form 365-3, and complete with initial entry from the completed Form B. Include a note identifying the reason for assembling a new handbook.

(7) Obtain the applicable aircraft -5 series TO as required.

(8) Obtain and prepare Form F, DD Form 365-4; Weight and Balance Clearance Form.

NOTE

If sufficient data is available to accurately reflect the aircraft's lost or damaged weight and balance data pages, as in the case of worn or water damaged pages or the AWBS, accomplish items 8.3.2f(1) through 8.3.2f(8) above as deemed necessary by the weight and balance authority. If there is not sufficient data to accurately duplicate the aircraft's lost or damaged pages or document, but sufficient data is available to assess the true weight and balance of the aircraft, only a note to the affect that the historical records cannot be duplicated, but the current weight and balance data is correct is all that is necessary.

g. Authorized Substitute Forms. Data sheets from the AWBS may be used in lieu of the DD Form 365, DD Form 365-1, DD Form 365-2, DD Form 365-3, and DD Form 365-4. Data sheets from computerized Form F generators may be used provided these sheets contain as a minimum, the necessary weight

and balance data as defined by the DD FORM 365 series forms, -5 series TO, and this TO.

8.3.4 Responsibilities.

a. Training Group.

(1) Air Education and Training Command (AETC) shall prepare and provide weight and balance instruction and training required for using unit compliance with USAF aircraft weight and balance control system.

b. Depot Level Maintenance.

(1) Air Logistics Complexes (ALCs) of AFMC shall prepare, procure, and disseminate aircraft weight and balance data that Commands require to comply with USAF aircraft weight and balance control system requirements. ALCs shall also provide and/or coordinate with AFLCMC technical assistance for unusual weight and balance problems as requested by Commands.

Supp D

c. Type Commander / Air Force Life Cycle Management Center (AFLCMC)

(1) The Air Force Life Cycle Management Center (AFLCMC) of the Air Force Materiel Command (AFMC) shall maintain overall responsibility for establishing the requirements, procedures, forms format, and AWBS for USAF aircraft weight and balance control. AFLCMC/EZFS is the office of primary responsibility for the following duties:

(a) Establishing the technical content and format of this manual, and the DD FORM 365 series forms.

(b) Provide recommendations to program offices concerning technical content and format of aircraft -5 series TOs for which AFLCMC has technical responsibility.

(c) Provide recommendations to program offices concerning AFTO Forms 22 and AF Forms 847 relative to documentation for which AFLCMC has technical responsibility.

(d) Determination and specification of USAF aircraft weight and balance classifications.

(e) Development of specialized weight and balance engineering services that may be requested by Air Logistics Complexes (ALCs).

(f) Coordination and recommendations to Air Education and Training Command (AETC) of changes in the USAF aircraft weight and balance control system that may necessitate revising the training curriculum of weight and balance courses.

(g) Coordination and recommendation of procedures and/or equipment required for compliance with the requirements of the weight and balance control system.

(h) Provide recommendations to program offices concerning weighing intervals for aircraft whose engineering responsibility is within AFLCMC.

(i) Acts as the USAF Technical OPR for the AWBS

d. Command Responsibilities. Commands shall establish effective operating procedures for weight and balance control of aircraft assigned to their command to ensure:

(1) The weight and balance control system requirements and procedures of this manual, and related TO documentation, are in accordance with the management procedures of AFI 21-101.

(2) When necessary, the Commands may impose more stringent requirements for weight and balance control through Command supplements to applicable Air Force manuals and instructions. The weight and balance control system requirements and procedures shall include, but not necessarily be limited to:

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

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

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

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

(e) Assisting flight crews in proper weigh and balance maintenance.

(f) Equipment is available, maintained, and/or certified as required for compliance with the applicable weight and balance directives.

(g) The using unit may implement procedures to simplify aircraft weight and balance maintenance which do not conflict with the aircraft -5 series TO, this document, or other applicable directives.

Table 8-7: Air Force Weight and Balance Personnel Qualification Requirements

Qualification Requirements	Weight and Balance Authority	Weight and Balance Manager	Weight and Balance Technician	Weight and Balance Custodian (Chart A and C only)
SUPP D AETC Computer Based Training: (J6ANW2AXXX 0W1A) Aircraft Weight and Balance Course or Commercial Equivalent of Aircraft Weight and Balance Course	Complete One	Complete One	Complete One	Complete One
AETC Course: J3AZR2AXXX 0W1B Weight and Balance Practical Course or Commercial equivalent of Weight and Balance Practical Course		Complete One	Complete One	
Automated Weight and Balance System Training via Lockheed Martin TIM (Technical Interchange Meeting) or Automated Weight and Balance System Training (Society of Allied Weight Engineers, SAWE)		Complete One	Complete One	Complete One
Witness or support 3 weighings done by qualified Weight and Balance Technician(s) per MDS that will be within scope Attend Weight and Balance TIM			Complete One	
Proven proficiency and ability to weigh aircraft to Weight and Balance Authority (i.e. successful supervised weigh)		Complete	Complete	
Documented experience weighing at least 4 aircraft per MDS of which authority will be over, within the last 12 months		Complete		

8.3.5 Personnel Qualification Requirements.

a. Military and government civilian personnel must be qualified as shown in Table 8-7.

(1) Weight and Balance Authority. Manages all Weight and Balance Personnel.

(a) Sign off on proficiency for each personnel qualification and individual designations

(b) Ensures weight and balance procedure(s) for unit are adhered to and requirements of this document are followed.

(c) May sign both “COMPUTED BY” and “WEIGHT AND BALANCE AUTHORITY” blocks on Form F.

(2) Weight and Balance Manager. The lead Weight and Balance Technician for a respective unit or base.

(a) May sign both “COMPUTED BY” and “WEIGHT AND BALANCE AUTHORITY” blocks on Form F.

(b) There may be multiple Weight and Balance Managers depending on the size of the unit and number of aircraft within their responsibility.

(c) May designate experienced Weight and Balance Technicians to sign on their behalf as "WEIGHT AND BALANCE AUTHORITY" block on Form F. Block required to state XX is signing on behalf of YY, Weight and Balance Authority.

(3) Weight and Balance Technician. Maintains all Weight and Balance Records for their respective aircraft.

(a) Weight and Balance Technicians are qualified to weigh aircraft

(b) Determine the proper amounts of ballast required to maintain the aircraft within the prescribed CG limits throughout its flight.

(c) May sign "COMPUTED BY" block on Form F.

(4) Weight and Balance Custodian. Personnel who will only be maintaining the Chart A and Chart C for their respective aircraft.

(a) Weight and Balance Custodians are not qualified to weigh aircraft.

(b) Not qualified to sign the Form F.

(c) Weight and Balance Custodian designations are for personnel whose aircraft are not weighed at their home-station

b. Commercial Equivalent classes, as shown in Table 8-7, must be approved by AFLCMC/EZFS. If unsure of class approval, contact AFLCMC/EZFS Mass Properties.

c. Weight and Balance Authority may waive the J3AZRAXXX 0W1B Weight and Balance Practical Course for individuals who are trained by current weight and balance qualified Weight and Balance Manager(s) or Technician(s) and certified by Weight and Balance Authority.

d. Civilian contractor qualifications will be verified by the contractor's engineering department or quality assurance office and may approve equivalent training that fulfills the intent of the requirements in Table 8-7.

(1) AFLCMC/EZFS may be contacted to verify training is sufficient and meets intended requirements.

e. Personnel qualified to weigh an MDS by another Department of Defense service are qualified to weigh the same USAF MDS.

NOTE

As an example, Navy personnel qualified by the Navy to weigh an F-35B and/or F-35C are qualified to weigh the F-35A

f. Maintaining Qualification.

(1) Weight and Balance Custodians, Technicians, and Managers shall attend an Automated Weight and Balance System Training at least once every 3 years. This ensures personnel are staying proficient with the software.

(2) Weight and Balance Technicians and Managers who weigh aircraft must weigh one aircraft for which they are approved on each year in order to remain qualified. Weight and Balance Authority shall ensure this requirement is met before personnel must get re- qualified.

(a) Bases or units that do not weigh aircraft within this timeframe may ensure qualification is maintained by other means such as:

1 Mock Weighing. The weighing procedure is discussed and a walk through of entire weighing procedure occurs.

2 Testing. Units may create a written test on weighing procedure of MDS.

3 Extend time requirement from 1 year to 2 years. Other methods such as the two previous methods are recommended if no weighings will occur within a 2-year time period.

8.3.6 Forms / Records Disposition. In accordance with AFRIMS - Record Disposition Schedule, the disposition of weight and balance documentation shall be as follows:

a. Record of Weight and Balance Personnel. Destroy after loss of aircraft.

b. Basic Weight Checklist Record (Chart A). Destroy after loss of aircraft or when superseded.

c. Aircraft Weighing Record (Form B). Destroy after loss of aircraft or when superseded.

d. Basic Weight and Balance Record (Chart C). Destroy after loss of aircraft.

e. Weight and Balance Clearance Form F.

(1) Prepared for each mission. Destroy on completion of mission.

(2) Related to an aircraft involved in an accident. Destroy 1 year after completion of investigation.

f. Standardized Form F.

(1) Destroy when superseded.

(2) Related to an aircraft involved in an accident. Destroy 1 year after completion of investigation.

8.3.7 Aircraft Classifications. See paragraph 3.6.

8.3.8 Form F.

a. Form F Procedures.

(1) Form F Maintenance Procedures. All Forms F shall be completed in accordance with Chapter 4 of this manual.

(a) One-Time Use Forms F. These are Forms F prepared for use on a One-Time basis and are destroyed upon mission completion. One-Time Use Forms F reflect a specific loading configuration applicable to a specific serial number aircraft. They are used when the Command does not utilize a standardized Form F approach or when an aircraft is loaded in a manner for which no standardized Form F is on file.

(b) Standardized Form F. These are Forms F which are prepared for repeated use to reflect a loading configuration that could apply to more than one aircraft of a specific MDS. If the Basic Weight and/or Basic Moment of any of the three baseline aircraft (discussed in 8.3.8b) changes, all existing Forms F based on standardized loadings using those aircraft must be replaced.

1 Standardized Forms F are filed in accordance with established Command procedures, for future reference and use.

2 Standardized Forms F shall be checked at least every 180 days for accuracy and a new Form F prepared as required. A new standardized Form F shall be prepared whenever Chart C Basic Weight and/or Moment changes accumulate to the threshold specified in the aircraft -5 series TO, or to the general requirements for Chart C threshold as specified in this TO. If no changes are required, the Form F may be re-dated and initialed, or a letter issued to state the review has been accomplished to certify its currency.

b. Standardized Loadings.

(1) The Weight and Balance Authority may approve for when missions permit, the use of standardized aircraft loadings. Standardized Forms F may be utilized with the following procedures to accomplish weight and balance flight clearance:

(a) The weight and balance handbooks for Class 2 aircraft of the same MDS shall be examined to determine which aircraft have the:

1 Most-forward Basic CG

2 Most-aft Basic CG

3 Heaviest Basic Weight

(2) These three aircraft shall then be used to establish the baseline for determining a standard loading arrangement that would enable all aircraft for that MDS to remain within limits. Other aircraft may be used in addition to the three baseline aircraft, if desired, or necessary for calculations of the aircraft weight and balance flight clearance.

(3) Once this loading arrangement has been verified within limits for all three baseline aircraft, the standard loading can be used to create Forms F for other aircraft of the same MDS. The loadings for which all aircraft remain within safe weight and balance limits for takeoff, flight, and landing may then be standardized.

(4) Aircraft Basic Weight and CG location is constantly changing through the incorporation of TCTOs, engine and equipment changes, modifications, and repairs. Therefore, the Weight and Balance Handbooks for all aircraft using Standardized Loadings shall be closely monitored.

c. Clearance Procedure.

(1) 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 365-4 or note that a Standardized Loading DD Form 365-4 is applicable. Duplicate copies of DD Form 365-4 shall be filed in accordance with Command operational procedures. DD Form 365-4 may be. One of the following entries shall be made in the appropriate space on DD Form 175:

(a) N/A - For Class 1 aircraft since weight and balance flight clearance is not required.

(b) ATTACHED - When a One-time Use DD Form 365-4 is attached.

(c) FILED AT DATE - when citing a previously filed standardized DD Form 365-4.

(d) ELECTRONIC – when DD Form 365-4 is filed with Flight Plan electronically.

d. Form F Signatures.

(1) Computed By: The signature of the individual completing the Form F. Must be qualified per 8.3.5.

(2) Weight and Balance Authority: The signature of the Weight and Balance Authority, Weight and Balance Manager, or qualified member of the aircraft.

(3) When selected, AWBS enables Weight and Balance Personnel to digitally sign Forms F using the PKI certificate on the user's CAC. For clarification purposes, this is not a full digital CAC signature. Use of AWBS electronic signature stamp is authorized for all USAF aviation activities. Selection of any one, all three, or any combination of signature blocks is possible, but only one PKI certificate will apply.

NOTE

AWBS electronic signature stamps are not mandatory, but are authorized for use. Use of PDF copies of Forms F with digital CAC signature, as well as pen and ink stamp all remain as viable options.

e. Authorized Substitutions for DD Form 365-4. The following substitutes are authorized for use as weight and balance clearance records in lieu of DD Form 365- 4.

(1) Electronic Computer data sheets may be used in lieu of the DD Form 365-4 provided these sheets contain, as a minimum, the necessary weight and balance data as defined by the -5 series TO to show load computations, Gross Weight and CG. The date, aircraft serial number, and signatures of responsible personnel shall be documented on the sheet. The sheet does not have to resemble the style or format of the actual DD Form 365-4.

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

(3) Computer programs that only produce the DD FORM 365-4 forms shall follow the requirements in Chapter 6 of this Technical Manual.

8.3.9 Aircraft Weighing.

a. It is acceptable to base the weight and CG on the Form B and Chart C of new production aircraft using the weight and CG of another aircraft in that same production lot.

b. Aircraft shall be weighed when any of the conditions listed in 3.9 are true.

c. Chart A inventory must occur within two days of weighing. Aircraft shall not be moved or have maintenance accomplished that may change the inventory results between the inventory and weighing. Aircraft who's weighing procedure span multiple days, Chart A inventory may not match the Form B weighing date.

d. When an aircraft is in a depot facility or other authorized weighing facility for any reason, and has not been weighed in five (5) years, (i.e., the most recent "as- weighed" Basic Weight entry in the Chart C is more than five (5) years ago) the aircraft shall be weighed. This applies unless a loading manual specifies a less restrictive requirement for a particular MDS aircraft.

e. Aircraft shall be weighed when major modifications or repairs are made that meet the following guidelines:

(1) The Servicing Engineering Organization or Lead Weight and Balance Specialist shall determine when an aircraft has undergone a "major modification or repair". As a guideline, a major modification or repair is one that affects 2% of Basic Weight or 500 lb., whichever is less, or changes the Basic Weight CG by 0.5% MAC for fixed-wing or 0.5 inches for rotary-wing.

(2) Determination of affected weight is based on the sum of items removed (excluding Chart A items) plus the weight sum of items added (excluding Chart A items).

(3) Affected weight is not the resultant change or difference between the two sums. For example, if 200 lbs. is removed and 300 lbs. is added for a modification, the affected weight is 500 lbs., not to be confused with the resultant change of +100 lbs.

(4) Weight and Balance Authority may determine a weigh is required if multiple modifications have been applied consecutively and meet this threshold of 500 lbs. of affected weight. These modifications may have been applied at different times and/or units.

NOTE

As an example, two modifications may occur within 3 months of each other, Mod #1 has an affected weight of 340 lbs. and Mod #2 has an affected weight of 270 lbs. Neither of these modifications required a weigh based on the affected weight requirement, but the Weight and Balance Authority may use their discretion to determine if a weigh should be accomplished after Mod #2 based on what was accomplished by each Mod. Because the two modifications meet the 500 lb. requirement when combined, this does not automatically trigger a weigh as they were done at separate times, as separate TCTOs.

8.3.10 Transfer / Acceptance Inventory.

a. Refer to AFI 21-103 for possession change requirements.

b. The Chart A inventory is required when an aircraft is transferred by the transferring unit.

c. The receiving unit shall also inventory the aircraft upon receiving the aircraft. If the receiving unit discovers any discrepancies during the inventory, the transferring unit shall be contacted to fix any Chart A or Chart C irregularities

d. If an aircraft is transferred to Depot / Maintenance Facility, an inventory is not required by Depot / Maintenance Facility upon receiving and transferring the aircraft unless otherwise required (i.e. TCTO requirement). If the aircraft is weighed while at Depot / Maintenance Facility, it shall be inventoried with the weigh.

8.3.11 Scales.

a. Scale Calibration. Scale calibration time intervals are determined by Air Force Metrology and Calibration (AFMETCAL).

b. Scale Accuracy. New scales shall have an accuracy of 0.1% of applied load or to the scale reading increment, whichever is greater. Recalibration of scales shall have the following accuracy requirements:

(1) 0.0% to 20.0% of scale capacity shall have an accuracy of 0.2% of applied load or to the scale reading increment, whichever is greater.

(2) 20.1% to 90.0% of scale capacity shall have an accuracy of 0.1% of applied load or to the scale reading increment, whichever is greater.

(3) 90.1% to 100.0% of scale capacity shall have an accuracy of 0.2% of applied load or to the scale reading increment, whichever is greater.

8.3.12 Unmanned Aerial Vehicles (UAVs).

a. Unique requirements of Unmanned Aerial Vehicles (UAVs) weighing less than 3,000 pounds (Basic Weight) allow for a deviation from this manual when they are routinely weighed and balanced every time the vehicle is reconfigured. These small UAVs are not required to maintain weight and balance handbooks in accordance with this manual.

b. An approved weight and balance system using forms and charts to calculate and record weight and balance data that meet the objectives of this manual shall be utilized.

8.3.13 Weight and Balance Guidance for Aircraft Modifications. TCTOs and modifications with changes less than two pounds for aircraft whose Basic Weight is under 25,000 pounds and changes less than five pounds for aircraft whose Basic Weight is over 25,000 pounds need not be recorded unless directed by TCTO or other directive.

8.3.14 AWBS Requirements.

a. The use of AWBS and Central Server is mandatory for all USAF activities unless operational security (OPSEC) requires use of paper forms. Requests to deviate from AWBS or the Central Server require approval from AFLCMC/EZFS.

b. The AWBS Central Server enables users to transfer, take ownership of, upload/backup and download/restore aircraft files. The Central Server shall be used as the primary method for backing up AWBS files. If OPSEC precludes using the Central

Server, local backup of AWBS data is the only method to store and recover data electronically.

c. The AWBS Central Server is suitable means for backing up aircraft data. Aircraft shall be uploaded/backed-up to the Central Server within seven (7) days of Chart A, Chart C, or Form B changes made.

d. It is acceptable for activities to utilize the paper DD Form 365-4 Clearance Form F for one-time use, as required. In these cases, no AWBS deviation authorization by AFLCMC/EZFS is required.

e. AWBS Software is available to USAF users by downloaded from the AWBS website https://awbs.hill.af.mil/. An AWBS account and CAC is required prior to download.

f. All AWBS users shall maintain an account for the AWBS website. This will ensure notification of AWBS updates, notification of AWBS Technical Interchange Meetings, access to AWBS issue resolutions, and access to the AWBS Central Server.

8.3.15 Contact Information.

a. AFLCMC/EZFS Mass Properties

(1) Email:

AFLCMC.EZ.WB.Tech.Orders@us.af.mil

(2) MAILING ADDRESS:
AFLCMC/EZFS (Mass Properties)
2145 MONAHAN WAY
BUILDING 28
WPAFB, OH 45433-7017

8.3.16 Corrections to This Manual. Changes or corrections to this manual are accomplished by submitting a Recommend Change on ETIMS (https://etims.cce.af.mil/ETIMS/index).

8.4 US COAST GUARD REQUIREMENTS. This section defines the requirements, procedures, and responsibilities relative to the USCG aircraft weight and balance program. The overall objectives of the program are to provide current and correct information regarding aircraft Basic Weight and moment, and to maintain aircraft Gross Weight and CG within permissible limits. All commands are responsible to assure that personnel designated as weight and balance authorities on Coast Guard aircraft are qualifi ed to perform the duties assigned.

8.4.1 Related References. Weight and balance personnel shall be familiar with the following related technical manuals (supplementary data to this manual) and other related documents:

a. Aircraft -1 Series Publication: Aircraft Flight Manual.

b. Aircraft -5 Series Publication: Sample Basic Weight Checklists and Loading Data.

c. Aircraft/Airframe Specific Maintenance Procedure Cards.

d. Aircraft/Airframe Specific Chart A - Basic Weight Check List.

e. Aircraft -9 Series Publication: Cargo Loading Manual.

f. COMDTINST M13020 Series: Aeronautical Engineering Maintenance Management Manual.

g. COMDTINST M3710 Series: Coast Guard Air Operations Manual.

h. CGTO PG-85-00-180: Aircraft Weight and Balance Process Guide.

8.4.2 Weight and Balance Control. Operational aircraft weight and balance control shall be accomplished in accordance with the requirements of CGTO PG-85-00-180 and the detailed instructions in aircraft -1 and -5 series publications in addition to the requirements of this manual. In case of conflicting requirements, procedures, or instructions, the aircraft specific publication shall take precedence over this manual pending resolution of the conflict.

a. Weight and Balance Handbooks. A weight and balance handbook is required for all active aircraft. An aircraft weight and balance handbook provides for the continuous record of the weight and balance of a particular aircraft. It is the primary tool utilized in maintaining weight and balance control for aircraft. Inactive aircraft (flyable temporary storage, static display, ground training, repair, etc.) do not require current and up-to-date weight and balance handbooks. If these inactive aircraft become active, the weight and balance handbook shall be updated with an actual weighing prior to first flight.

(1) Non-current copies of the charts and forms may be filed (paper or electronic) for historical purposes and shall be available whenever requested by ALC. These historical charts and forms shall be transferred with the aircraft whenever the aircraft is transferred. See CGTO PG-85-00-180 for handbook content information.

NOTE

If the -5 series publication is in the form of multiple publications, only the Loading Data needs to be included with each handbook. The Sample Basic Weight Checklist does not have to be included.

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

c. Handbook Replacement. In the event an aircraft's weight and balance handbook or pages becomes lost, is damaged, or for any reason needs to be replaced, the individual assigned responsibility for that aircraft handbook shall assemble a new handbook. If electronic data is not locally available to reproduce the content, contact ALC Operations.

8.4.3 Responsibilities.

a. Aviation Training Center (ATC). ATC shall provide initial training of pilots on Basic Weight and balance concepts to include introduction to electronic forms of weight and balance management.

b. Aviation Logistics Center (ALC). ALC shall provide:

(1) Officials to certify the weight of Coast Guard aircraft.

(2) Accurate documentation reflecting aircraft configuration and baseline weight and balance.

(3) Access, training and utilization information to electronic applications utilized for aircraft weight and balance configuration management.

c. Air Station. Air Stations shall establish effective operating procedures for weight and balance configuration management of aircraft assigned to their command.

8.4.4 Personnel Qualification Requirements.

a. Military and civilian personnel assigned the responsibility for accomplishing the various weight and balance functions are qualified by completing an ALC approved course of instruction. Personnel that do not have the responsibility to weigh aircraft shall have training for familiarization of weight and balance chart and form maintenance.

NOTE

Civilian contractor qualifications will be verified by the contractors engineering department. Contractor's engineering department may approve equivalent training that fulfills the intent of the above paragraph.

8.4.5 Forms / Records Disposition. For information on disposition of forms and records refer to Aircraft Weight and Balance Process Guide CGTO PG-85-00-180.

8.4.6 Aircraft Classifications. Refer to the aircraft specific publications for loading control. All manned and unmanned aircraft where weight and balance class is not stated in the aircraft specific publications shall be considered Class 2. Class 2 aircraft are those with published weight and CG limits that can be readily exceeded by normally employed loading arrangements and therefore need a higher degree of loading control.

8.4.7 Form F.

a. Form F Maintenance Procedures. Electronic data sheets from approved Form F generators may be utilized in lieu of DD Form 365-4. See CGTO PG-85-00-180. All Forms F shall be completed in accordance with the instructions of this TO. Forms F are utilized on a ONE TIME USE basis, or are standardized for multiple use.

(1) ONE TIME USE Form F. These are Forms F prepared for use on a one time basis and are destroyed upon mission completion. They are generally used when the Air Station does not utilize standardized Forms F or when an aircraft is loaded in a manner for which no CANNED Form F is on file.

(2) CANNED Form F. These are Forms F which are prepared for multiple use when an aircraft's Basic Weight and moment remain within certain specified tolerances. They are filed in accordance with established Air Station procedures, for future reference and use. New standardized Forms F shall be prepared whenever Chart C Basic Weight and/or moment changes.

b. Standardized Loadings.

(1) Standardized (formerly CANNED) Forms F. At the option of the Air Station weight and balance personnel and when missions permit, the use of standardized aircraft loadings, standardized Forms F, may be utilized ensuring that the aircraft remains within its most forward and aft CG configuration.

(2) Aircraft Basic Weight and CG location is constantly changing through the incorporation of TCTOs, equipment changes, modifications, and repairs. Therefore, the weight and balance handbooks for all aircraft involved in these standard loading procedures shall be closely monitored. Aircraft Basic Weight and CG location shall remain within the weight limits, most forward CG and most aft CG conditions of the aircraft.

8.4.8 Aircraft Weighings.

a. Aircraft Weighing Requirements. Aircraft shall be weighed when any of the following conditions exist:

(1) At initial delivery to Coast Guard inventory.

(2) Following Programmed Depot Maintenance (PDM).

(3) When TCTOs, modifications or structural repairs are made that affect the weight and balance of the aircraft and calculated or actual weight and moment data are not available.

(4) When the calculated weight and balance data is suspected of being in error.

(5) When the aircraft is painted and the weight and balance impact has not been provided.

NOTE

Painting can drastically change aircraft weight and balance. If an aircraft is completely painted (many aircraft -5 series technical orders have more restrictive requirements), and the responsible Service Engineering Organization has not evaluated and provided the weight and balance impact for the work accomplished, the aircraft will be weighed.

(6) When unsatisfactory flight characteristics are reported which cannot definitely be determined as caused by faulty flight control system, improper loading, or error in weight and balance data and/or computations.

(7) Whenever specified by ACMS.

b. Weighing Intervals. Aircraft will be weighed during scheduled PDM and as required per applicable aircraft publications or ALC Product Line Engineering.

8.4.9 Transfer / Acceptance Inventory. A complete Chart A inventory shall be accomplished whenever possession changes as directed by individual aircraft maintenance procedure cards (MPC).

8.4.10 Scales.

a. Scale Calibration. Scale calibration intervals are determined by scale manufacturer recommendations.

b. Scale Accuracy.

(1) New scales shall have an accuracy of 0.1% of applied load. Recalibration of scales shall have the following accuracy requirements:

(a) 0.0% to 20.0% of scale capacity shall have an accuracy of 0.2% of applied load.

(b) 20.1% to 90.0% of scale capacity shall have an accuracy of 0.1% of applied load.

(c) 90.1% to 100.0% of scale capacity shall have an accuracy of 0.2% of applied load.

(2) Individual scales shall not be used when the applied load (i.e. reaction to be measured when weighing the aircraft) is less than the lowest load applied during scale calibration.

NOTE

Aircraft scales are usually calibrated in increments of 10% of the scale capacity. For example, a 60,000 lb. capacity scale calibration record usually shows the lowest load applied during calibration is 6,000 lb. (10% of scale capacity).

(3) If the weighing technician intends to use a scale to measure applied loads that are less than 10% of the scale capacity, the scales shall be calibrated to lower applied loads and documented in the scale calibration records.

(4) Do not use a scale whose display increment is less than the required 0.1% calibration accuracy.

NOTE

For example, if the scale displays in increments of 10 pounds it will not be used to measure an applied load of 10000 pounds or less.

8.4.11 Unmanned Aerial Vehicles (UAVs). Unique requirements of Unmanned Aerial Vehicles (UAVs) weighing less than 3,000 pounds allow for a deviation from this TO when they are routinely weighed and balanced every time the vehicle is reconfigured. These small UAVs are not required to maintain weight and balance handbooks in accordance with this TO. However, an approved weight and balance system using forms and charts to calculate and record weight and balance data that meet the objectives of this paragraph shall be utilized.

8.4.12 Weight and Balance Guidance for Aircraft Modifications. See Aircraft Weight and Balance Process Guide CGTO PG-85-00-180 and TCTO/SCTO Process guide CGTO PG-85-00-40-A.

8.4.13 Contact Information. ALC Operations Division. For information on the Coast Guard Weight and Balance program visit:

https://uscg.sharepoint-mil.us/sites/alc_spo/SitePages/AWBS.aspx

MAILING ADDRESS:

USCG Aviation Logistics
Center Operations Division
Weight and Balance Program Manager
1664 Weeksville Road, BLDG 64
Elizabeth City, NC 27909 - 5001

8.4.14 Corrections to This Manual. Corrections to this manual will be through utilization of the CG-22 system.

8.4.15 Distribution of AWBS.

a. Individual installations of AWBS 11 may be obtained by going to the Apple App store on IPads and the Storefront https://storefront.osc.uscg.mil/esd/home/ for desktop/laptop comuters.

APPENDIX A
Terminology and Definitions

ACTUAL WEIGHT. The weight of a component, subassembly or the entire aircraft as determined by actually weighing at least one representative article. Frequently the actual weight for record keeping purposes is an average of several representative articles.

AFT CENTER OF GRAVITY LIMIT. The aft center of gravity limit is the most aft (rearward) permissible aircraft center of gravity location for a specific weight and configuration. Center of Gravity may be expressed in inches, %MAC or index.

AIRCRAFT MODIFICATION. Change in the physical characteristics of an aircraft accomplished either by a change in production specifications or by alteration of items already produced.

AIRCRAFT REFERENCE AXES. A set of three mutually perpendicular reference lines (longitudinal, lateral, and vertical) established to define the basic geometry of a major aircraft component, such as the wing, fuselage or nacelle. Each Model, Design, or Series aircraft have their unique reference axes which shall be provided to the customer or user of the aircraft. The fuselage reference system is normally used as the common set of axes in locating the aircraft center of gravity. The aircraft reference system shall be defined early in the aircraft development and is usually located in front of the aircraft and below the static ground level to eliminate the need for negative arms. However, the lateral reference axis is usually located down the centerline of the aircraft to make symmetrical calculations easier.

AIRCRAFT WEIGHING RECORD. An Aircraft Weighing Record, DD Form 365-2, is the form used to record data obtained from aircraft actual weighings and to derive the Basic Weight and Moment from the As- Weighed Weight and Moment.

AMMUNITION. Projectiles, such as bullets and shot, together with their fuses and primers that can be fired from guns or otherwise propelled.

ARM. An arm is the distance of the center of gravity of an item from a reference datum. When computing arms: note that arms are not additive, and shall be calculated by dividing the moment (not simplified) by the weight.

AUTOMATED FORM F (AFF) GENERATOR. An AFF is an electronic Form F Generator that is used to determine the aircraft weight and center of gravity location for any flight or ground configuration and produce a Form F.

AUTOMATED WEIGHT AND BALANCE SYSTEM (AWBS). The Automated Weight and Balance System is a software application that enables computer-based management of aircraft records as a replacement for DD 365 series forms. Aircraft weight data and loading arrangements may be updated digitally which improves efficiency and reduces mathematical errors.

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.

BALLAST. Ballast is weight specifically put in an aircraft to remain within permissible center of gravity limits.

BASIC ARM or BASIC CG. The basic arm or basic CG is the distance from the reference datum to the aircraft center of gravity consistent with the Basic Weight condition. Basic arm or basic CG is determined by dividing the aircraft basic moment by the aircraft Basic Weight.

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 total weight of the aircraft, installed systems, and items necessary for basic flight operation. Basic Weight is independent of mission and establishes the starting basis for all mission loading scenarios. Examples of items in Basic Weight may be guns, unusable fuel, oil, ballast, oxygen, and internal and external equipment not disposed of during flight. The current Basic Weight is the last entry on Chart C either in the Basic Weight column in AWBS or in the CURRENT TOTAL BASIC AIRCRAFT column using DD 365-3.

BASIC WEIGHT AND BALANCE RECORD. The Basic Weight and Balance Record is a series of DD Forms 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 CHECKLIST RECORD. The Basic Weight Checklist Record is a completed collection of DD Form 365-1, referred to as Chart A. It is a list of equipment by aircraft compartment that is, or can be, installed in the aircraft.

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

CENTER OF GRAVITY (CG). The center of gravity, CG, is a point at which an item's weight is concentrated and about which the item would balance if suspended. Center of Gravity may be expressed in inches, %MAC or index.

CENTRAL SERVER. A web service designed to store electronic aircraft records when using AWBS. When correctly configured, and with proper permissions, users can export aircraft records to the Central Server and import aircraft records from the Central Server. The Central Server acts as a central repository or transfer hub for aircraft records.

CHART A. See BASIC WEIGHT CHECKLIST RECORD.

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 surface).

COMPARTMENT. Compartments, or Sub-compartments, are specific locations or zones in or on an aircraft where Chart A or Chart E items are found. They are intended to help approximate the location of items and facilitate inventory.

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.

DATUM. See REFERENCE DATUM.

DD FORM 365. See RECORD OF WEIGHT AND BALANCE PERSONNEL.

DD FORM 365-1. See BASIC WEIGHT CHECKLIST RECORD.

DD FORM 365-2. See AIRCRAFT WEIGHING RECORD.

DD FORM 365-3. See BASIC WEIGHT AND BALANCE RECORD.

DD FORM 365-4. See WEIGHT AND BALANCE CLEARANCE FORM.

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

EMERGENCY EQUIPMENT. Any emergency equipment not included in Basic Weight.

EXPENDABLE. Includes items that will be or could be consumed or disposed of during flight such as usable fuel, paratroops, airdrop cargo, ammunition, missiles, rockets, bombs, flares or chaff.

EXPENDABLE PAYLOAD. A payload item that is planned to be expended (released from the aircraft) during flight.

EXPENDABLE STORE. An aircraft store such as weapons, external fuel tanks, pyrotechnic devices, sonobuoys, signal and underwater sound devices or other similar items that may be separated from the aircraft in flight under normal situations. These items are included in Worst Case calculations.

FLOOR LOADING. Floor loading is the weight of a load divided by the area of the floor upon which the weight is placed. Specific Aircrew Flight Manual, Cargo Loading Manuals, and/or Charts E will usually specify floor loading limits and total load capacity for various compartments of the aircraft.

FORM B. See AIRCRAFT 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. Center of Gravity limits may be expressed in inches, %MAC, or index.

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

FUSELAGE STATION (**AIRCRAFT STATION**). Fuselage stations are reference locations measured in the longitudinal direction (forward or aft) from a reference datum which is usually well forward of the aircraft. A station forward of the reference datum is negative (-) while a station aft of the reference datum is positive (+).

GROSS WEIGHT (GW). Gross Weight is the total weight of the aircraft at any time, including its contents and externally-mounted items. The Gross Weight is continually changing throughout fl ight and/or ground operations so, typically, a value is usually qualified for a particular phase of flight.

GROUP A (A-KIT). Group A items are provisions for avionics line replaceable units (LRUs or WRAs). Group A items include wires, wire bundles, cables, RF transmission lines, connecting devices, mounting hardware, cooling plumbing and ducting, and items required for the installation of antennas, LRUs, WRAs, control displays, etc.

GROUP B (B-KIT). Group B items are those “black boxes” such as antennas, LRUs, WRAs, control and displays that are easily replaceable items in the electronic system.

IN AIRCRAFT. Basic Weight items on the aircraft during aircraft inventory and noted on DD FORM 365-1 BASIC WEIGHT CHECKLIST RECORD.

INDEX. See LOAD ADJUSTER INDEX.

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

LATERAL AXIS. An axis from side to side of an aircraft (along the wing span).

LEADING EDGE OF THE MEAN AERODYNAMIC CHORD (LEMAC). The LEMAC is the distance from the longitudinal reference datum to the leading edge of the Mean Aerodynamic Chord (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 that represents moment on the aircraft load adjuster and, in conjunction with aircraft weight or index formula, permits center of gravity calculations.

LOAD ITEM. Any item that has a size and weight value that is added to an airframe/platform and is not considered part of Basic Weight. Load items could be crew, crew baggage, fixed equipment, emergency equipment, internal cargo items, external cargo items, sling loads, external stores, expendable items, non-expendable items, jettisonable items, fuel or temporary ballast. These items are listed in the Chart E.

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

LOADING DATA (Chart E). Loading Data contains instructions for aircraft actual weighing, 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.

LONGITUDINAL AXIS. The fore and aft axis. It is normally the fore and aft axis through the center of the aircraft.

LRU. Line Replaceable Unit (similar to WRA).

MASS PROPERTIES. Mass properties is the term that refers to weight, center of gravity, and moment of inertia of an item.

MASTER CHART A. Chart A that standardizes the basic weight checklist for a specific MDS/TMS aircraft. May be in either a DD 365-1 or electronic format. Master Charts A may include illustrations/drawings/photos/part numbers to aid in the inventory process.

MDS (MISSION/DESIGN/SERIES). MDS – Refers to the model or Mission/Design/Series (i.e. F-16A, F-4E, C-141B, UH-1Y, etc.), which is synonymous with TMS (Type/Model/Series).

MEAN AERODYNAMIC CORD (MAC). The theoretical average or mean chord of a lifting surface such as the wing of a fixed-wing aircraft. Typically, a wing chord is longer at the root near the body and it tapers to a shorter chord at the tip. The MAC is an overall average chord representative of an entire wing used in aerodynamic computations and analysis.

MISCELLANEOUS VARIABLES. As required by the Command. Reference 9 on the DD Form 365-4.

MOMENT. Moment is a measure of a tendency to rotate an object due to a force applied at a particular point on the object. In aircraft weight and balance, the moment of an item is the weight (force) of the item multiplied by its balance arm.

NON-EXPENDABLE PAYLOAD. A payload item that is retained throughout the mission from take-off to landing.

NON-EXPENDABLE STORE. A store such as a rack, launcher, pod, internal fuel tank, or other similar item that will not separate from the aircraft in flight under normal operations. These items are not included in Worst Case calculations.

OPERATING ITEMS. Operating items include crew, and aircraft / mission dependent items such as internal and external auxiliary fuel tanks, guns, weapon suspension and release equipment, cargo handling equipment, crew baggage, steward equipment, special mission fixed equipment and emergency items which are not included in Basic Weight.

OPERATING WEIGHT. Operating Weight is the sum of aircraft Basic Weight and operating items.

PASSENGER. A passenger is any occupant on the aircraft not performing a crew duty and not logging flying time.

PAYLOAD. Payload is any item that is being transported and is directly related to the mission or purpose of the flight as opposed to items that are necessary for the flight operation. Payload can include, but is not limited to, passengers, cargo, passenger baggage, ammo, internal and external stores, and fuel that are to be delivered to another aircraft or site. Payload may or may not be expended in flight. Payload is a type of Load Item.

PERCENT MAC (% MAC). Percent MAC expresses a location along the aircraft longitudinal axis as a percentage of the mean aerodynamic chord of the aircraft.

PERMANENT BALLAST. Permanent ballast is ballast which is required to be in the aircraft at all times and is a CHART A item.

RAMP WEIGHT. Gross Weight of the aircraft prior to engine start and defined as Operating Weight plus usable fuel plus payload.

REACTION. See WEIGHING REACTION POINTS.

RECORD OF WEIGHT AND BALANCE PERSONNEL. 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 handbook.

REFERENCE DATUM. A reference datum is an imaginary plane from which distances are measured for aircraft weight and balance purposes. The balance arm of a reference datum is by definition zero. Aircraft have three reference datum from which balance arms are measured, longitudinal (using fuselage station), lateral (using buttlines), and vertical (using waterlines) reference datum. The three reference datum are always perpendicular to each other. The longitudinal reference datum is usually forward of the nose, the lateral reference datum is usually parallel to the aircraft centerline, and the vertical datum is usually well below the aircraft. Balance arms are determined relative to the horizontal reference datum.

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 gravitation correction factors which depend on the latitude where the scale/load cell is used. Refer to the scale's applicable manual for the appropriate factors.

SERIAL NUMBER. Bureau Number for USN/USMC.

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

SIMPLIFIED MOMENT. Simplifi ed moment is a moment divided by an established constant such as 10, 100, 1000, 10,000, or 100,000. The value of the constant is identifi ed in the Charts A and E for the aircraft.

TAKEOFF GROSS WEIGHT (TOGW). The Gross Weight of the aircraft at the time the aircraft becomes airborne and defi ned as Ramp Weight minus taxi fuel.

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 can also include a Scale Correction Factor.

TEMPORARY BALLAST. Temporary ballast is a Form F operating item 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 specifi c loading condition.

TOTAL AIRCRAFT WEIGHT. The sum of Operating Weight, fuel, and water injection fluid (if applicable).

TRAPPED FUEL. Trapped fuel is the fuel that remains in an aircraft after utilizing applicable technical manuals to defuel the aircraft and drain individual tanks and lines.

TYPE/MODEL/SERIES (TMS). Designation of an aircraft design such as F/A-18E, MH-60S or MV-22B. TMS is synonymous with MDS (Mission/Design/Series).

UNUSABLE FUEL. Unusable fuel is the fuel remaining in the aircraft after engine fuel starvation when the aircraft is in a specified attitude.

USABLE FUEL. Fuel onboard at engine start and available for aircraft operations.

USEFUL LOAD. Useful load is the difference between Basic Weight and Gross Weight plus items necessary for basic fl ight operations such as unusable fuel, engine oil, oxygen and fi xed armament. Useful Load includes fuel, oil, crew, passengers, cargo, and other items carried as necessary for mission execution.

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

WATER INJECTION. For aircraft using water injection engines.

REACTION POINT. A reaction point is a point upon which the aircraft weight is supported during weighing.

WEIGHT AND BALANCE AUTHORITY. Person who has the responsibility to ensure the weight and balance work is complete and correct.

WEIGHT AND BALANCE CUSTODIAN. Qualified person assigned to weight and balance work.

WEIGHT AND BALANCE CLEARANCE FORM. The Weight and Balance Clearance Form, DD Form 365-4, is referred to as Form F. The Form F 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.

WEIGHT AND BALANCE TECHNICIAN. Qualified person assigned to weight and balance work.

WRA. Weapons Replaceable Assembly. Similar to LRU.

ZERO FUEL CENTER OF GRAVITY (ZFCG). Zero Fue Center of Gravity is the CG of the loaded aircraft without any usable fuel.

ZERO FUEL WEIGHT (ZFW). Zero Fuel Weight is the weight of the loaded aircraft without any usable fuel. See also Maximum Zero Fuel Weight.

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APPENDIX B
Acronyms

ACMS Aviation Computerized Maintenance System

AETC Air Education and Training Command

AFF Automated Form F Generator

AFI Air Force Instruction

AFLCMC Air Force Life Cycle Management Center

AFMC Air Force Materiel Command

AFRIMS Air Force Records Information Management System

ALC Air/Aviation Logistics Center

AMMO Ammunition

AR Army Regulation

AWBS Automated Weight and Balance System

BL Buttline

BUNO Bureau Number

CAAS Common Avionics Architecture System

CAC Common Access Card

CGTO Coast Guard Technical Order

COMDTINST Commandant Instruction

COR Contracting Officer's Representative

CG Center of Gravity

CNATT Center for Naval Aviation Technical Training

DA Department of the Army

DD/DOD Department of Defense

EPM Enhanced Phase Maintenance

FMS Flight Management System

FRC Fleet Readiness Center

FS Fuselage Station

FWD Forward

GUMC Gear Up Moment Change

GW Gross Weight

JDRS Joint Discrepancy Reporting System

LEMAC Leading Edge of the Mean Aerodynamic Chord

MAC Mean Aerodynamic Chord

MAJCOM Major Command

MDS Mission/Design/Series

MMCO Maintenance/Material Control Officer

MOM Moment

MWO Modification Work Order

NATOPS Naval Air Training and Operating Procedures Standardization

NATIP Naval Aviation Technical Information Product

NAVAIRSYSCOM Naval Air Systems Command

NSWC Naval Surface Warfare Center

PG Process Guide

REF Reference

SDLM Standard Depot Level Maintenance

TB Technical Bulletin

TCTO Time Compliance Technical Order

TD Technical Directive

TM Technical Manual

TMS Type/Model/Series

TO Technical Order

TPDR Technical Publication Discrepancy Report

UAS Unmanned Air System

UAV Unmanned Air Vehicle

WAM Weight x Arm = Moment

Wt Weight

%MAC Percent Mean Aerodynamic Chord

APPENDIX C
Scale Corrections Block Table Factors

Table C-1. Latitude and Altitude

Degree	0 ft.	1000 ft.	2000 ft.	3000 ft.	4000 ft.	5000 ft.	6000 ft.	7000 ft.
0	1.0027	1.0028	1.0029	1.0030	1.0031	1.0032	1.0033	1.0034
5	1.0026	1.0027	1.0028	1.0029	1.0030	1.0031	1.0032	1.0033
10	1.0025	1.0026	1.0027	1.0028	1.0029	1.0030	1.0031	1.0032
15	1.0023	1.0024	1.0025	1.0026	1.0027	1.0028	1.0029	1.0030
20	1.0021	1.0022	1.0023	1.0024	1.0025	1.0025	1.0026	1.0027
25	1.0017	1.0018	1.0019	1.0020	1.0021	1.0022	1.0023	1.0024
30	1.0014	1.0015	1.0016	1.0017	1.0017	1.0018	1.0019	1.0020
35	1.0009	1.0010	1.0011	1.0012	1.0013	1.0014	1.0015	1.0016
40	1.0005	1.0006	1.0007	1.0008	1.0009	1.0010	1.0011	1.0012
45	1.0000	1.0001	1.0002	1.0003	1.0004	1.0005	1.0006	1.0007
50	0.9996	0.9997	0.9998	0.9999	1.0000	1.0001	1.0002	1.0003
55	0.9991	0.9992	0.9993	0.9994	0.9995	0.9996	0.9997	0.9998
60	0.9987	0.9988	0.9989	0.9990	0.9991	0.9992	0.9993	0.9994
65	0.9983	0.9984	0.9985	0.9986	0.9987	0.9988	0.9989	0.9990
70	0.9980	0.9981	0.9982	0.9983	0.9984	0.9985	0.9986	0.9987
75	0.9978	0.9979	0.9979	0.9980	0.9981	0.9982	0.9983	0.9984
80	0.9976	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981	0.9982
85	0.9974	0.9975	0.9976	0.9977	0.9978	0.9979	0.9980	0.9981
90	0.9974	0.9975	0.9976	0.9977	0.9978	0.9979	0.9980	0.9981

C.1 EXAMPLE. An aircraft is weighed in a hanger at 30 degrees latitude and an altitude of 2000 ft MSL.

C.1.1 Multiply each scale reading by the correction factor of 1.0016 and enter the result on the Form B for each reaction weight. (15,000 lbs x 1.0016 = 15,024 lbs).

NOTE

Scales are calibrated to 45 degrees latitude and 0 feet altitude.

All scales should be adjusted to current location of aircraft weighing.

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APPENDIX D
SAMPLE DD 365 FORMS

Figure 0-1 Sample DD365 Pesonnel Record

RECORD OF WEIGHT AND BALANCE PERSONNEL	*FOR USE WITH T.O. 1-1B-50, NAVAIR 01-1B-50, TM-55-1500-342-23*	*Form Approved OMB No. 0704-0188*

The public reporting burden for this collection of information is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Executive Services Directorate (0704-0188). *Respondents should* be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does *not display a* currently valid OMB control number.

MISSION DESIGN SERIES or TYPE/MODEL/SERIES	SERIAL NUMBER or BUREAU NUMBER

LAST NAME	FIRST NAME	M. I.	GRADE, RATE, OR RANK	QUALIFYING ORGANIZATION	WHEN QUALIFIED *(YYYYMMDD)*	STATION	DATE ASSIGNED *(YYYYMMDD)*	DATE RELIEVED *(YYYYMMDD)*

DD FORM 365, AUG 96 PREVIOUS EDITION MAY BE USED. Reset Adobe Professional 7.0

Figure 0-2 Sample DD365-1 Basic Weight Checklist Record

Form Approved. OMB No. 0704-0188

FOR USE WITH T.O. 1-1B-50, NAVAIR 01-1B-50, AND TM-55-1500-342-23

CHART A - BASIC WEIGHT CHECKLIST RECORD

The public reporting burden for this collection of information is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Executive Services Directorate (0704-0188). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION.

PAGE OF PAGES	MISSION DESIGN SERIES or TYPE/MODEL/SERIES	SERIAL NO. or BUREAU NO.	CONSTANT
COMPARTMENT	COMPARTMENT DESCRIPTION	COMPARTMENT LIMITS	

INVENTORY DATE AND LOCATION *(YYYYMMDD)*

ITEM NUMBER	PART NUMBER / ID	ITEM DESCRIPTION OR SUBCOMPARTMENT	WEIGHT UNITS: ____	ARM UNITS: ____	MOMENT UNITS: ____	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 365-1, AUG 96 PREVIOUS EDITION MAY BE USED

Figure 0-3 Sample DD365-2 Aircraft Weighing Record

FORM B AIRCRAFT WEIGHING RECORD	FOR USE WITH: Joint Technical Manual (JTM) - Aircraft Weight and Balance TO 1-1B-50, NAVAIR NA 01-1B-50, AND TM 55-1500-342-23	Form Approved OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Executive Services Directorate (0704-0188). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.
PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION.

DATE WEIGHED (YYYYMMDD)	MISSION DESIGN SERIES or TYPE/MODEL/SERIES			SERIAL NUMBER or BUREAU NUMBER			
PLACE WEIGHED	PERSON RESPONSIBLE FOR WEIGHING (Last, First, M.I.)			DUTY PHONE NO / EMAIL ADDRESS			
Prior to Weighing Last Entry On Chart C (See Page 3 of DD 365-2)	Basic Weight		Arm or %MAC				
Allowable Weighing Tolerances (See JTM Chapter 5.5 Table 5-1)	Basic Weight (low)		Basic Weight (high)		Arm or %MAC (low)		Arm or % MAC (High)

REACTION (Wheels, Jack Points, Etc.)	SCALE READING	CORRECTIONS (see below)	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.)

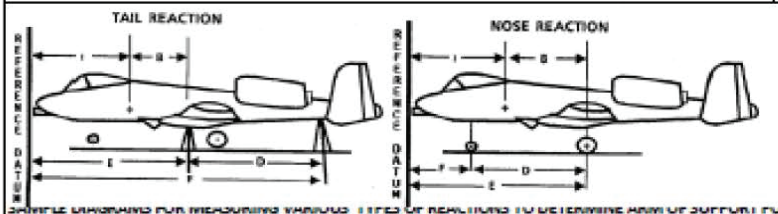
D = _____ the distance between the main and nose or tail reaction. Obtain by measurement.

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)

CORRECTIONS

	LEFT MAIN	RIGHT MAIN	NOSE or TAIL
CALIBR. CORRECTION			
LATITUDE ALTITUDE CORRECTION			
SCALE CORRECTION			
TEMPERATURE _____ [2]			
EQUIPMENT			
OTHER			
TOTAL			



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

See Aircraft Chart E or other manual(s) for specific weighing instructions.

[1] *Check dimensions E and F against approximate dimensions listed on Chart E.*
[2] *Enter temperature at time of weighing.*

DD FORM 365-2, MMM YY — PREVIOUS EDITION MAY BE USED

DESCRIPTION	NET WEIGHT	ARM	MOMENT	[1] INDEX OR MOMENT /
TOTAL (As weighed) (From front side)				
NON-LEVEL WEIGH ARM OR MOMENT CORRECTION				
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 WEIGHT (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	SCALE TYPE SERIAL NUMBER CALIBRATION DATE (YYYYMMDD) CALIBRATED ACCURACY

REMARKS

Enter the following, at a minimum:

- Aircraft clean (yes/no)?
- Aircraft dry (yes/nc
- Fuel system condition (dry, trapped, or full using open-port method)
- Fuel density X.X pounds per gallon, (if fuel system is ful
- Weighed in level or non-level condition?
- Aircraft weighed at 0 degrees nose up attitude, or x.x degrees nose up attitude
- Inside enclosed hangar (yes/no)?
- Using jack/load-cells or platform scales?
- Scale Settings (if applicable): Altitude and Lattiude

Additional Remarks

[1] Enter constant used

DD FORM 365-2 (PAGE 2), MMM YY

VERIFICATION OF RESULTS

If the weighing results are within the Weighing Tolerances, no further action is required.

If the weighirg results **ARE NOT** within the Weighing Tolerances, complete the actions below.
DO NOT REMOVE THE AIRCRAFT FROM THE WEIGHING FACILITY UNTIL ALL OF THE VERIFICATION STEPS ARE COMPLETE.

Refer to JTM "VERIFICATION OF WEIGHING RESULTS" and applicable aircraft weighing instructions for more information and further instruction.

	Verification Step	Verification Step Completed By (Last Name, First Name, Middle Initial)[1]
1	Check Form B calculations and measurements for errors.	
2	Check scales for overdue calibration.	
3	Check scales for correct altitude and latitude adjustments in accordance with the scale manufacturer's procedures.	
4	Check slope of facility being used for weighing.	
5	Check the accuracy of the level (spirit, inclinometer, or digital protractor).	
6	Check and ensure that hangar doors are closed, and that all fans and heaters are off.	
7	Check the plumb bob or other leveling equipment for proper installation. i.e. String positioned in center of bracket V-notch. Does the plumb bob, digital protractor, or other leveling tool show required longitudinal and lateral angles/alignment?	
8	Check aircraft (inside and out) to ensure that it is clean and completely dry.	
9	Check to ensure chocks, flight gear, survival kits, fly-away gear, blade ropes, engine covers, and other non-Basic Weight items were removed.	
10	Check that aircraft doors and panels were in proper configuration.	
11	Check fuel tank sump drains for lack of fuel flow making sure an appropriate container is in place in the event of fuel discharge. If fuel is discharged, then repeat the defuel procedure to the trapped fuel state, and re-weigh the aircraft.	
12	If authorized to weigh with full fuel tanks, check fuel quantity and density. See JTM for additional instructions.	
13	Check Chart C for errors since the last weighing.	
	a. Verify that Chart A updates have been properly reflected in Chart C.	
	b. Verify that all aircraft modifications have been accounted for.	
	c. Verify Chart A inventory matches the aircraft's weighing condition. If not, then re-inventory the aircraft.	
14	Ensure that any maintenance action taken place between when the aircraft was inventoried and when it was weighed has been accounted for.	

NOTES:

[1] Initials acceptable on subsequent lines completed by same named person

DD FORM 365-2 (PAGE 3), MMM YY

Figure 0-4 Sample DD365-3 Basic Weight and Balance Record

CHART C - BASIC WEIGHT AND BALANCE RECORD

FOR USE WITH T.O. 1-1B-50, NAVAIR 01-1B-50, AND TM-55-1500-342-23

Form Approved OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Executive Services Directorate (0704-0188). Respondents should be aware that notwithstanding any other provision of law, no person *shall be subject to* any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION.

MISSON DESIGN SERIES or TYPE/MODEL/SERIES	SERIAL NUMBER or BUREAU NUMBER	CONSTANT

DATE (YYYYMMDD)	ACTION [1]	ITEM NO.	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE			CURRENT TOTAL BASIC AIRCRAFT			
				WEIGHT UNITS:	ARM UNITS:	SIMPLFIED MOMENT UNITS:	WEIGHT UNITS:	SIMPLFIED MOMENT UNITS:	ARM OR INDEX [2] UNITS:	% MAC

1 H=Header, A=Addition, S= Chart C Review, I=Inventory, R=Removal, W=Weighing
2 Load adjuster index.

PAGE NUMBER: _____

DD FORM 365-3, AUG 96 PREVIOUS EDITION MAY BE USED.

MISSON DESIGN SERIES or TYPE/MODEL/SERIES	SERIAL NUMBER or BUREAU NUMBER	CONSTANT

DATE (*YYYYMMDD*)	ACTION [1]	ITEM NO.	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE			CURRENT TOTAL BASIC AIRCRAFT			
				WEIGHT UNITS: ______	ARM UNITS: ______	SIMPLFIED MOMENT UNITS: ______	WEIGHT UNITS: ______	SIMPLFIED MOMENT UNITS: ______	ARM OR INDEX [2] UNITS: ______	% MAC

1 H=Header, A=Addition, S= Chart C Review, I=Inventory, R=Removal, W=Weighing
2 Load adjuster index.

PAGE NUMBER: ___________

DD FORM 365-3, AUG 96 PREVIOUS EDITION MAY BE USED.

Figure 0-5 Sample DD Form 365-4 Weight and Balance Clearance Form F

WEIGHT AND BALANCE CLEARANCE FORM F

FOR USE WITH T.O. 1-1B-50, NAVAIR 01-1B-50, AND TM-55-1500-342-23

DATE (YYYYMMDD)	MDS OR TMS		FROM	HOME STATION	
MISSION	SERIAL NO. or BUNO		TO	PILOT	

REMARKS	REF	ITEM	WEIGHT	MOMENT/
	1	BASIC AIRCRAFT (From Chart C)		
	3	OPERATING ITEMS + NON-EXPENDABLE PAYLOAD		
		REF 3 Overflow (See Page 3)		
	4	OPERATING CONDITION		
	6	EXPENDABLE PAYLOAD ITEMS		
		REF 6 Overflow (See Page 3)		
	7	ZERO FUEL CONDITION		
		ZERO FUEL CG (% MAC OR IN)		
	8	USABLE FUEL		
	9	MISC. VARIABLES		
	10	RAMP CONDITION		
	11	RAMP CG (% MAC OR IN)		
	12	TAKEOFF CORRECTIONS (If required)		
	13	TAKEOFF CONDITION		
	14	TAKEOFF CG (% MAC OR IN)		
	15	TAKEOFF FUEL		
		LESS EXPENDABLES (See REF 6)		
		LESS EXPENDABLES Overflow (See Page 3)		
	16	ESTIMATED LANDING FUEL		
	17	ESTIMATED LANDING CONDITION		
	18	ESTIMATED LANDING CG (% MAC OR IN)		

TAKEOFF CORRECTIONS (REF 12)		
	CHANGES (+ or -)	
ITEM	WEIGHT	MOMENT/
TOTAL (REF 12)		

MOST FWD CALCULATION	WEIGHT	MOMENT/
OPERATING CONDITION		
ADD MOST FWD FUEL		
ADD FWD EXPENDABLES		
(See FWD EXPENDABLES TABLE)		
MOST FWD CONDITION		
MOST FWD CG (% MAC OR IN)		

MOST AFT CALCULATION	WEIGHT	MOMENT/
OPERATING CONDITION		
ADD MOST AFT FUEL		
ADD AFT EXPENDABLES		
(See AFT EXPENDABLES TABLE)		
MOST AFT CONDITION		
MOST AFT CG (% MAC OR IN)		

LIMITATIONS	ACTUAL	LIMIT
RAMP WEIGHT (LB)		
TAKEOFF WEIGHT (LB)		
LANDING WEIGHT (LB)		
ZERO FUEL WEIGHT (LB)		

	FWD LIMIT	ACTUAL	AFT LIMIT
RAMP CG (% MAC or IN)			
TAKEOFF CG (% MAC or IN)			
LANDING CG (% MAC or IN)			
ZERO FUEL CG (% MAC or IN)			
MOST FWD CG (% MAC or IN)			
MOST AFT CG (% MAC or IN)			

COMPUTED BY SIGNATURE

WEIGHT AND BALANCE AUTHORITY SIGNATURE

PILOT SIGNATURE

FOR MOST FWD AND AFT CALCULATIONS

OPERATING CONDITION (REF 4)	
WEIGHT	
MOMENT/	
CG (IN)	

FWD EXPENDABLES TABLE FOR MOST FWD CALCULATION

FWD EXPENDABLE ITEM	ARM (IN)	WEIGHT	MOMENT/
FWD relative to the Operating CG			
SUM "ADD FWD EXPENDABLES" (TRANSFER TO FRONT)			

AFT EXPENDABLES TABLE FOR MOST AFT CALCULATION

AFT EXPENDABLE ITEM	ARM (IN)	WEIGHT	MOMENT/
AFT relative to the Operating CG			
SUM "ADD AFT EXPENDABLES" (TRANSFER TO FRONT)			

REF 3 OPERATING ITEMS + NON-EXPENDABLE PAYLOAD (Overflow)

	WEIGHT	MOMENT/
TOTAL (Transfer to Front under REF 3)		

LESS EXPENDABLES (Overflow)

	WEIGHT	MOMENT/
TOTAL (Transfer to Front)		

REF 6 EXPENDABLE PAYLOAD ITEMS (Overflow)

	WEIGHT	MOMENT/
TOTAL (Transfer to Front under REF 6)		

USAF SUPPLEMENT
TECHNICAL MANUAL

TO 1-1B-50D SUPERCEDES TO 1-1B-50C

PURPOSE: This technical publication is issued for the purpose of supplementing a joint service manual.

TITLE: Aircraft Weight and Balance
ADDITIONAL IDENTIFICATION: NAVAIR 01-1B-50
DATE: 12 SEPTEMBER 2023

Published under authority of the Secretary of the Air Force

1 Page number 8-22, paragraph 8.3.4.d.(1)

ADD: Depots will use AFMCI 21-100, *Depot Maintenance Production*.

2 Page number 8-23, Table 8-7

REPLACE: J6ANW2AXXX 0W1A with J6ANW2AXXX 0W1B