

MIL-W-25140B
31 October 1977
SUPERSEDING
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MILITARY SPECIFICATION

WEIGHT AND BALANCE CONTROL SYSTEM (FOR AIRCRAFT AND ROTORCRAFT)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers the requirements for Weight and Balance Control Systems to provide for the management of mass characteristics programs and to facilitate the preparation and submission of data in standard format during the life of an aircraft or rotorcraft contract (see 3.3).

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS

MILITARY

| | |
|------------|---|
| MIL-F-5572 | Fuel, Aircraft Reciprocating Engine, Grades 80, 91/96, 100/130, 115/145 |
| MIL-F-5624 | Fuel, Aircraft Turbine and Jet Engine Grades JP-3, JP-4, and JP-5 |
| MIL-M-5920 | Manuals, Technical, Basic Weight Check List and Loading Data |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 1500

MIL-W-25140B

SPECIFICATIONS (Continued)

APPROVED WEIGHING FORMS

| | |
|--------------|---|
| AN-9249 | Aircraft Actual Weight and Horizontal Balance |
| AN-9250 | Aircraft Actual Weight and Vertical Balance |
| DD Form 365B | Aircraft Weighing Record |

STANDARDS

MILITARY

| | |
|--------------|---|
| MIL-STD-480 | Configuration Control - Engineering Changes, Deviations and Waivers |
| MIL-STD-1374 | Weight and Balance Data Reporting Forms for Aircraft (Including Rotorcraft) |
| Part I | Group Weight Statement |
| Part II | Detail Weight Statement |
| Part III | Weight and Balance Status |

PUBLICATIONS

TECHNICAL MANUALS

The requirements for these manuals are specified in the text of this specification under the title "Weight Handbook." Reference to any one of the service manuals in the Contract Data Requirements List (DD Form 1423) shall mean "Weight Handbook."

T.O. 1-1B-40 (Air Force) Handbook, Weight and Balance Data

T.O. 1-1B-50 (Air Force)

NA 01-1B-40 (Navy)

TM 55-405-9 (Army)

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

MIL-W-25140B

3. REQUIREMENTS

3.1 General. The data covered by this specification are intended for use in determining compliance with contractual requirements for the management of weight and balance control systems of aircraft during design and construction, in establishing a system of weight and balance control for operation of the aircraft, and in preparing balance computers for class 2 aircraft. The instructions and requirements of MIL-STD-1374 shall be applied in the compilation of data for Parts I and II, the Group and Detail Weight Statements, required in aircraft weight reports.

3.2 Weight and balance control system. The contractor is required to provide a Weight and Balance Control System that will ensure Weight Control Management (1) through assignment of competent personnel, (2) by utilizing adequate measuring devices and facilities, (3) by defining techniques to be initiated to offset adverse trends, (4) by defining requirements to sub-contractors and (5) by holding constructive periodic design reviews. The contractor's system is subject to review and validation by the procuring agency. During pre-award negotiation or immediately following contract award, representatives of the prime contractor or associate contractors shall consult with the procuring agency in certifying the procedure for Program Weight and Balance Control including the submission of a Weight Control and Management Program Plan Report. Part of the Plan Report shall be devoted to specifying the detailed interface between the Work Break-down Structure system as described by MIL-STD-881A and the Group and Detailed Weight Statements.

3.3 Submittal of data. The weight and balance data specified herein shall be submitted by the contractor during study, research and development or production contracts in accordance with the data acquisition provisions of the contract. Normally, Contract Data Requirements List (DD Form 1423) identifies by Data Item Description (DD Form 1664) the quantity, frequency and distribution of specific weight and balance data for a contract. For other contracts, data may be specified by reference to specific paragraphs herein.

3.3.1 Specification weight derivation. During the negotiation stage of preparing a contract detail specification, the contractor shall furnish a derivation of the vehicle weight for each draft of the specification until the weight status of the final draft is represented. The derivation shall be based on the design proposal (on prototype or actual data when available) and shall be furnished on the Status Report Form MIL-STD-1374, Part III. A description shall be appended explaining the reasons for the weight changes since the previous draft. A list of weight of Government Furnished Equipment, upon which the weights are based, shall be attached.

MIL-W-25140B

3.3.2 Post design weight analysis report. This report shall be prepared for an aircraft designated by the procuring agency and shall be submitted no later than 90 days after the aircraft is weighed. The purpose of the report is to provide, in a single document, a record of design criteria, integrated design concept, and weight information which will serve as a baseline working document to be used during the acquisition phase and contract service life. A chronology of major design and/or weight changes will be included to provide background information on the aircraft design evolution. The detailed content and format of this report shall be prepared by the contractor and submitted for approval to the procuring agency. Compilation of the data for this report shall begin as of the contract date. It shall be updated commensurate with the design development of the aircraft and shall be maintained in an informal but organized status. This informal data shall be available for review by the procuring agency as an aid during program weight reviews. The report shall be divided into four major sections consisting of:

a. Pre-contract development. This section shall document the configuration development from the contractor's initial proposal and ending with the aircraft configuration at contract award.

b. Contract design development. This section shall document the mass properties control program, including a history of weight and design changes resulting from this program. This section shall also include all significant design development changes, in chronological order, from contract award to the designated aircraft.

c. Detail design analysis. This section shall present the description and analysis of the designated aircraft. Included in this section shall be an aircraft general description, Group and Detail Weight Statements, criteria, and detail design description and functional analyses for each structural and system group.

d. Appendices. The procuring agency will require, unless specifically waived, an appendix to this report. The agency will specify the effectivity of the appendix (i.e. to which aircraft, by production number, the appendix shall be applicable) and the submittal date, which will usually be close to the IOC (initial operational capability) date.

(1) The appendix shall describe the changes made to the given aircraft as well as a short description of the service problems or defects that precipitated the changes. It is intended that the appendix to the Post Design Weight Analysis Report will provide a running account of the weight history from the designated aircraft of paragraph c above.

(2) On subsequent contracts the procuring agency may require further appendices to cover later changes. In such cases the procuring agency will specify the submittal dates and effectivities as above.

3.4 Weight and balance classification. For weight and balance control purposes, aircraft are divided into the following classifications.

3.4.1 Class 1A. Class 1A aircraft are those whose recommended weight or c.g. limits can not be exceeded by loading arrangements normally employed in tactical operations, and therefore need no loading control.

3.4.2 Class 1B. Class 1B aircraft are those whose recommended weight or c.g. limits sometimes can be exceeded by loading arrangements normally employed in tactical operations, and therefore need loading control.

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

3.4.4 Classification assignment. Weight and balance classifications will be determined by the procuring activity and assigned in the aircraft detail specification.

3.5 Handbooks and balance computers. The requirements outlined below for the Weight Handbook and balance computer apply to production and preproduction aircraft.

3.5.1 Class 1A aircraft. There are no requirements for data to be delivered aboard Class 1A aircraft. Charts A and E for the Weight Handbook as specified herein shall be furnished to the procuring activity to provide data for use by field weight and balance personnel and overhaul activities in periodic weight and balance checks.

3.5.2 Class 1B aircraft. The contractor shall complete the Weight Handbook which shall be placed in the data case of each aircraft prior to delivery.

3.5.3 Class 2 aircraft. The contractor shall complete the Weight Handbook which shall be placed in the data case of each aircraft prior to delivery. If Government-furnished balance computers are not received prior to delivery of any aircraft on Navy contracts, the information furnished in Figure 1 shall be inserted in the front of the applicable Weight Handbooks.

3.6 Weight and balance data.

3.6.1 Preproduction contract. Unless otherwise specified, the following weight and balance data, and necessary weighings, are required under a preproduction contract:

- a. Estimated Weight Report.
- b. Weight and Balance Status Report.

MIL-W-25140B

IMPORTANT NOTICE

Subj: Model _____, Balance Computer - Instructions
Concerning

The balance computer, Load Adjuster Plate _____, was not available for installation in this aircraft prior to delivery. Chart E shall be used in the interim. The weight and balance personnel of the activity receiving this aircraft shall complete the form shown below and forward it to the indicated addressee. Arrangements will be made to have the Load Adjuster furnished as soon as available. Upon receipt of the Load Adjuster, the following shall be accomplished:

- (1) Install the Load Adjuster on the clip located _____ (Contractor shall give location).
- (2) Insert the Instruction Pamphlet (provided with each Load Adjuster) at the end of Section 3 of the Weight Handbook installed in the aircraft.
- (3) Remove this sheet from the handbook.

To: Commander, Naval Air Systems Command
Attn: Evaluation Division, Weight Control Branch (AIR-5062)
Washington, D.C. 20361

Model _____ Aircraft, Bureau No. _____, was delivered by the contractor prior to the availability of the Load Adjuster. Arrange for shipment of the one Load Adjuster, Plate _____, to the following addressee.

(Contractor to fill in
aircraft model, and plate
number if available)

Signature _____
(Weight and Balance Personnel)

FIGURE 1. Notice to be inserted in the Weight Handbook if Government-furnished balance computers are not received prior to aircraft delivery.

MIL-W-25140E

c. **Calculated Weight Report:** The requirements for the Calculated Weight Report may be eliminated or reduced upon specific approval by the procuring activity.

d. **Sample Charts A and E.**

e. **Actual Weight Report - First Aircraft.**

f. **Appendices to Actual Weight Reports** required prior to conducting procuring activity tests.

g. **Final Appendices to Actual Weight Reports.**

h. **Actual Weight Report: Intermediate and Last Aircraft.** If a contract provides for more than one preproduction aircraft, an Actual Weight Report - Intermediate Aircraft shall be submitted for each additional aircraft unless otherwise stated in the contract. If only minor changes have been made since the last previous Actual Weight Report, a report detailing these changes, (including their effect on actual and contract/guarantee weight and balance, and the contractor responsibility under or overweight) will be sufficient.

i. If alternate power plant installations, alternate wings, or other alternate major components are included in the program, weight and balance information shall be supplied for all alternate items and for the complete aircraft with the alternate items installed. These data shall be included as an appendix to the applicable calculated and actual weight reports. Actual weighings of alternate components and, if necessary, the complete aircraft with alternate components installed shall be made to insure accurate data.

3.6.2 **Production contract.** The following weight and balance data, and necessary weighings, are required under a production contract:

a. **Estimated Weight Report.**

b. **Weight and Balance Status Report:** Required when specifically requested by the procuring activity.

c. **Calculated Weight Report:** If an Actual Weight Report has been submitted for preproduction aircraft and only minor changes have been made on the production aircraft, a report detailing these changes and their effect on the calculated and contract/guaranteed weight and balance will be sufficient.

d. **Sample Charts A and E.**

MIL-W-25140B

e. Actual Weight Report - First Aircraft: With the specific approval of the procuring activity, the Detail Weight Statement (MIL-STD-1374, Part II), the weight empty detail balance calculations, and all vertical c.g. data may be omitted from this report, and furnished in the report for the fifth aircraft.

f. Appendices to Actual Weight Reports required prior to conducting procuring activity tests.

g. Final Appendices to Actual Weight Reports.

h. Actual Weight Report - Intermediate Aircraft: Reports shall be submitted as follows:

(1) For the 5th and 10th aircraft.

(2) Each 20th aircraft. Weighings or reports may also be required for any other aircraft when specifically requested by the procuring activity. This applies particularly in the case of production contracts for a small quantity of aircraft, or a very low production rate. Where possible, reports shall be scheduled for the first aircraft in which major changes or an accumulation of minor changes are incorporated. Therefore, the contractor shall submit to the procuring activity a proposed revised schedule when the production blocks are initially established, when major changes, program deceleration, cumulative effect of changes and major re-scheduling of blocks warrant further adjustment, and when selection of aircraft for procuring activity tests (Navy demonstration and trials) is made. Minor deviations from the schedule may be approved by the local representative of the procuring activity, and appropriate note of the deviation included in the letter submitting the report.

1. Actual Weight Report - Last Aircraft.

j. If a contract is for the same type of aircraft, without major changes, and is to run consecutively to a previous contract, any or all of the following modifications to the above requirements may be made, subject to specific approval by the procuring activity:

(1) Omit the Estimated, Calculated, and Weight Status Reports.

(2) Omit the Actual Weight Report - Last Aircraft on the previous contract.

(3) Substitute an Actual Weight Report - Intermediate Aircraft for the Actual Weight Report - First Aircraft.

(4) Omit the appendices to the Actual Weight Reports.

(5) Omit the Actual Weight Report - Intermediate Aircraft for the 5th and 10th aircraft.

k. Printed copies of released and revised Charts A and E as specified in 3.7.9.6.

3.6.3 Engineering Change Proposals (ECP's). Data affecting weight and balance shall be furnished in the comparable form of Figure 2 as an enclosure to appropriate ECP's. The submittal and preparation of ECP's is governed by MIL-STD-480, Configuration Control - Engineering Changes, Deviations and Waivers. A separate copy of the weight breakdown of the ECP shall be submitted directly to the cognizant Air Force mass properties engineer when specifically requested. The data shall be resubmitted, as above, when ECP's are revised or when Specification Change Notices (SCN's) and Contract Change Notices (CCN's) differ from previously submitted data. Summaries may be submitted in lieu of the Figure 2 format when the resubmittal is identical to the initial ECP weight data. The following requirements also apply:

a. The weight breakdown shall be furnished in enough detail to allow weight accountability for MIL-STD-1374, Part II items affected. No breakdown is required for a structural change of less than 10 pounds when the total ECP affects only one air vehicle part. Change affecting more than one part shall be treated in a manner indicated by Figure 2 regardless of the net weight change involved. The weight report on which the weight breakdown and balance data are based shall be referenced by number, date, and title. Weights of Government-Furnished Aircraft Equipment (GFAE) items deleted shall be the specified weights on which the current guaranteed weight empty is based. The weights of GFAE items added, upon which the revised contract/guaranteed weight empty will be based, shall specifically be listed. In any case, where the change in contract/guaranteed weight empty will differ materially from the change in predicted weight empty, because of differences between specified and predicted weights of GFAE or other reasons, appropriate comment shall be included calling attention to and indicating the magnitude of the differences in weight and c.g. changes.

b. The useful load change shall be given for all missions on which performance guarantees are based and for all weight conditions that are critical for design of the vehicle.

c. When a proposed change involves a large c.g. shift, information or comment shall be included to justify that loadings exceeding anticipated c.g. limits will not result.

d. When a proposed change involves a major modification of one aircraft or group of aircraft, the data required above shall be submitted in the form of a brief weight report deriving the calculated and contract/guaranteed weight and balance of the modified aircraft, normal loading, and the most forward and aft loading conditions.

MIL-W-251408

 ECP NO. _____
 Date _____
 Prepared by: _____

 MODEL XYZ - CONTRACT 00000 - WEIGHT INCREASE
 FOR CHANGE FROM TWO TO FOUR 20MM GUN INSTALLATION

| | GFAZ | CONTRACTOR- FURNISHED MATERIAL | ARM INCHES | MOMENT INCH. LBS. |
|---|---------|--------------------------------------|---------------|----------------------|
| WEIGHT EMPTY | | | | |
| ITEMS REMOVED | (0) | (- 81.5) | | (-22675) |
| Gun and Ammunition Box | | - 19.0 | 275.0 | - 5225 |
| Access Doors | | | | |
| Ammunition Feed and Case | | - 1.3 | 273.5 | - 356 |
| Ejection Chutes | | | | |
| Gun Mounts and Supports | | - 4.2 | 254.8 | - 1070 |
| Cabling, Wiring and Plugs | | - 17.0 | 307.3 | - 5224 |
| Gun Beams and Support Frames | | - 34.0 | 270.0 | - 9180 |
| Ammunition Compartment Floor | | - 6.0 | 270.0 | - 1620 |
| ITEMS ADDED | (0) | (+122.0) | | (+33762) |
| Gun and Ammunition Box | | 28.5 | 274.5 | 7623 |
| Access Doors | | | | |
| Ammunition Feed and Case | | 3.6 | 273.5 | 985 |
| Ejection Chutes | | | | |
| Gun Mounts and Supports | | 8.4 | 254.8 | 2140 |
| Cabling, Wiring and Plugs | | 21.7 | 307.3 | 6668 |
| Gun Beams and Support Frames | | 49.8 | 270.0 | 13446 |
| Ammunition Compartment Floor | | 10.0 | 270.0 | 2700 |
| Total Weight Empty Change | 0 | + 40.5 lb. | | +11087 |
| USEFUL LOAD | | | | |
| ITEMS ADDED: | | | | |
| Gun, Adapter & Retainers (2) | 204.8 | | 269.0 | 55091 |
| Aft Gun Mount - UPR. (2) | | 4.0 | 272.0 | 1088 |
| Feed Mechanism - UPR. L/R (2) | 26.0 | | 278.0 | 7228 |
| Case and Link Ejection Chute - UPR. L/R | | 6.0 | 277.0 | 1662 |
| Ammunition Box - UPR. L/R | | 16.0 | 277.0 | 4432 |
| Mountings and Misc. Equipment | | 49.9 | 270.0 | 13473 |
| Ammunition 250 Rds. | 177.0 | | 273.0 | 48321 |
| Total Useful Load Change | 407.8 | 75.9 | | + 76260 |
| Gross Weight Change | | +483.7 lb. | 157.6 | + 76260 |
| *GROSS WEIGHT, GUNFIGHTER | 28003 | | 166.6 | 87347 |
| GROSS WEIGHT CHANGES | 324.2 | | 454.8 | 12736133 |
| REVISED GROSS WEIGHT | 28327.2 | | 166.6 | 87347 |
| | | | 449.5 | 12823480 |

The gross weight c.g. is moved 5.3 inches or 3.7 percent MAC.

*Weight and Balance Report Number 24569 dated 1 June 1971.

FIGURE 2. Sample weight and balance breakdown for ECP's.

3.6.4 Amended preproduction and production contract. If a contract is amended to provide for a major modification of one aircraft or group of aircraft, the contractor shall submit the following additional reports as soon as data are available (data previously submitted for the proposed change may be referenced and need not be duplicated):

a. Actual Weight Report - Intermediate Aircraft for the first modified aircraft, except that partial or complete detail weight statement and balance calculations as necessary shall be included to show differences over the detailed data furnished for the basic aircraft.

b. Revised sample Charts A and E, when applicable. If the modification to the aircraft does not require these charts to be changed, a written statement to that effect will fulfill this requirement.

c. The procuring activity will specify what additional actual weight reports are required when the contract is amended.

3.6.5 Contract for modification of new classes 1A, 1B, and 2 aircraft subsequent to acceptance and prior to service. The following requirements shall apply:

a. Sample Charts A and E shall be submitted if revision of the balance computer is necessary because of modifications incorporated.

b. Appendices shall be submitted to the weight reports for applicable blocks furnished under the production contract requirements. These appendices shall detail the modifications incorporated, their effect on weight empty, useful loads, gross weights, the extreme c.g. conditions, and the basic weight data. Representative aircraft shall be weighed after modification, preferably the same aircraft which were weighed under the production contract requirements, and an approved weighing form and derivation of the weight empty included in the appendices. The appendices shall be submitted not later than 30 days after the aircraft are weighed. Subject to approval by the procuring activity, the reweighing of aircraft may be omitted when changes in weight and balance are minor.

c. For classes 1B and 2 aircraft, the Weight Handbook shall be brought up to date. If charts are extensively revised, new charts shall be prepared and inserted.

d. Printed copies of released, or revised, Charts A and E shall be submitted as specified in 3.7.9.6.

MIL-W-25140B

3.6.6 Contract for modification classes 1A, 1B, and 2 aircraft returned from service. The following requirements shall apply:

a. Sample Charts A and E shall be submitted if revision of the balance computer is necessary because of modifications incorporated.

b. Each aircraft shall be weighed after modification. Each aircraft shall be weighed prior to modification unless specifically waived by the procuring activity.

c. One copy of the weighing form, and the completed Charts A, C, and E for the 1st, 10th, 20th, and each subsequent 20th modified aircraft shall be submitted to the procuring activity not later than 30 days after the aircraft is weighed, with a listing of serial numbers, basic weights, arms, and moments (corrected to a standard typical inventory to permit comparison of weight and c.g. variations) for all aircraft modified during that period.

d. For classes 1B and 2 aircraft, the Charts A, C, and E data in the Weight Handbook shall be brought up to date. If the charts are extensively revised, new charts shall be inserted. A new handbook shall be prepared if the original has been mutilated or lost.

e. Subject to approval by the procuring activity, the requirements of 3.6.5 may be substituted for aircraft returned for modification after limited service.

3.7 Preparation of data. Each weight and status report shall be bound in a single folder with the data given in the order specified herein. The configuration of the aircraft for which data are submitted shall represent the official or contractual configuration since the original specification, as modified by changes of applicable effectivity. Pending changes shall not be included unless they have appropriate effectivity.

3.7.1 Weight and Balance Status Report. Unless otherwise specified, this report shall be submitted every month beginning immediately after the contract is let, and continuing on preproduction contracts until the Actual Weight Report is submitted for the aircraft as delivered to the procuring activity for final tests (for Navy, Part II and III demonstrations and the trials) and on production contracts until the Actual Weight Report for the first production aircraft is submitted. Additional submittals will be required by the procuring activity if weight or c.g. are considered to show an undesirable trend. The Weight and Balance Status Report (MIL-STD-1374, Part III) shall represent the status as determined by the contractor's running weight control records at the end of the period noted by the date on the form, and shall be submitted not later than 15 days after completion

of the design phase represented by the report. Formal acceptance or approval by the procuring activity is required for the status reports. The following general instructions shall apply in their preparation:

a. In the initial issue of the status report, the contractor may reallocate weights among the weight groups of the original specification or the original guarantee weight empty, as deemed necessary from the best information available at the time, provided that specified weights of GFAE and the total specification or contract/guaranteed weight empty and useful load are unchanged. The purpose of this reallocation is to afford an opportunity for revising the contract/guaranteed weight breakdown to represent the then best available information on weight distribution and c.g. This distribution, as modified by later decreases and increases for Government responsibility changes and GFAE variations, will serve as the basis for determining under or overweight of the various groups. The group under or overweights are for comparative purposes only, since the contractor guarantees the total weight empty rather than the group breakdown. When such reallocations are made, complete information on all weight transfers among the groups, and their effect on c.g., shall be furnished as an appendix to the initial issue of the report. If the Estimated Weight Report has already been furnished, any major differences which will affect the use of the Estimated Weight Report as a reference source for arm and c.g. data shall also be included.

b. The initial issue of the status report shall include reference to the source of the recommended c.g. limits, brief indication of the critical flying qualities or structural considerations which dictated these limits, and reasons for any tapered or special c.g. restrictions. Similar data shall be furnished whenever limits are revised.

c. When mockup changes are introduced into the status report, complete information shall be submitted as an appendix to that issue, including brief descriptive identification of the changes, weights, arms, and moments, and a summary of their effect on the contract/guaranteed and predicted weight and balance of the aircraft.

d. A brief discussion shall be included with each issue of the status report describing the reasons for all major contractor responsibility weight variations and c.g. shifts, including any remedial measures being investigated or applied.

e. At the times when the current weight status and c.g. are brought into agreement with the Calculated Weight Report and the results of the actual weighing of the completed aircraft, appropriate note to this effect shall be made, and the Calculated or Actual Weight Report shall be referenced by number, date, and title.

MIL-W-25140B

f. During the flight test phase, if changes in the current weight status in a status report period are less than 0.25 percent of the weight empty or 25 pounds, whichever is the larger, and the weight empty c.g. shift is less than 0.5 percent MAC for aircraft or 0.5 inch for rotorcraft, the status report for that period may be omitted and the procuring activity notified by letter; however, a report shall be submitted when the cumulative effect of changes since the last report reaches these values.

g. If a major modification is to be incorporated in one or a group of aircraft on the contract, information on the weight and c.g. status of the modified aircraft shall be included as an appendix to the status report. Status information furnished may be in the form of differences over the basic model, and shall continue as a separate report, if necessary, until the modified aircraft is delivered to the procuring activity for final tests (for Navy, Part II and III demonstrations and the trials).

3.7.2 Estimated Weight Report. This report shall be submitted after the contract has been awarded, but not later than 30 days after contract signing. Weights shown in this report shall be accurate and complete, and shall be in agreement with the original contract/guaranteed weight empty. The following data shall be included in the report in the order shown:

a. A table summarizing the weight, moments of inertia and c.g. (horizontal, lateral and vertical) data for the weight empty and all gross weight conditions covered in the balance calculations. Dimensional data (suitably illustrated by a small profile sketch of the aircraft) locating the horizontal and vertical moment axes and MAC or main rotor centerline shall be given below the table. The recommended c.g. limits shall be shown on, or tabulated below, the profile sketch. Refer to paragraph 3.7.1(b).

b. Group Weight Statement: (MIL-STD-1374, Part I)

c. Detail Weight Statement: (MIL-STD-1374, Part II)
This statement is intended primarily to show that all power plant and equipment items have been considered; all groups, however, shall be detailed as completely as the data will permit at this stage of the design.

d. The following weight and balance calculations
(Refer to Section 3.8):

(1) Weight empty detail balance calculations
(including alternate lighting gear).

(2) Gross weight balance calculations for all loading conditions listed in the aircraft contract detail specification, and for the most forward and the most aft loading conditions attainable as defined in this specification. When an aircraft can be operated with more than one type of fuel, data shall be included for all types.

(3) Derivation of the moment change owing to retracting the alighting gear.

(4) Weight, arm, and moment data for all alternate or special load items for which provision is made, and the effect on the primary or other applicable load condition.

e. Center of Gravity Envelope diagram showing a plot of weight vs c.g. similar to Figure 3 for all loading conditions listed in the specifications and for the most forward and aft loading condition attainable to illustrate the effect of expendable and variable items of useful load and alighting gear retraction.

f. List of GFAE and weights.

g. Structural diagrams of wing, rotors (for rotorcraft), tail, body, nacelles, and alighting gear showing and identifying the following, as appropriate:

(1) Dimension from the reference datum for the horizontal and vertical moment arms to a convenient fixed point on the component.

(2) Scales in inches for determining horizontal and vertical dimensions.

(3) Principle structural stations and dimension to structural station 0 of the component.

(4) Location of the leading edge and length of the MAC or rotor centerlines.

(5) Surfaces, such as ailerons, flaps and other high lift devices, rudder, elevator, etc., with hinge lines shown in correct locations.

(6) Spar locations, major joints, and fold axes.

(7) Fuel tanks, wheel wells, bomb bays, and other major cutouts.

MIL-W-25140B

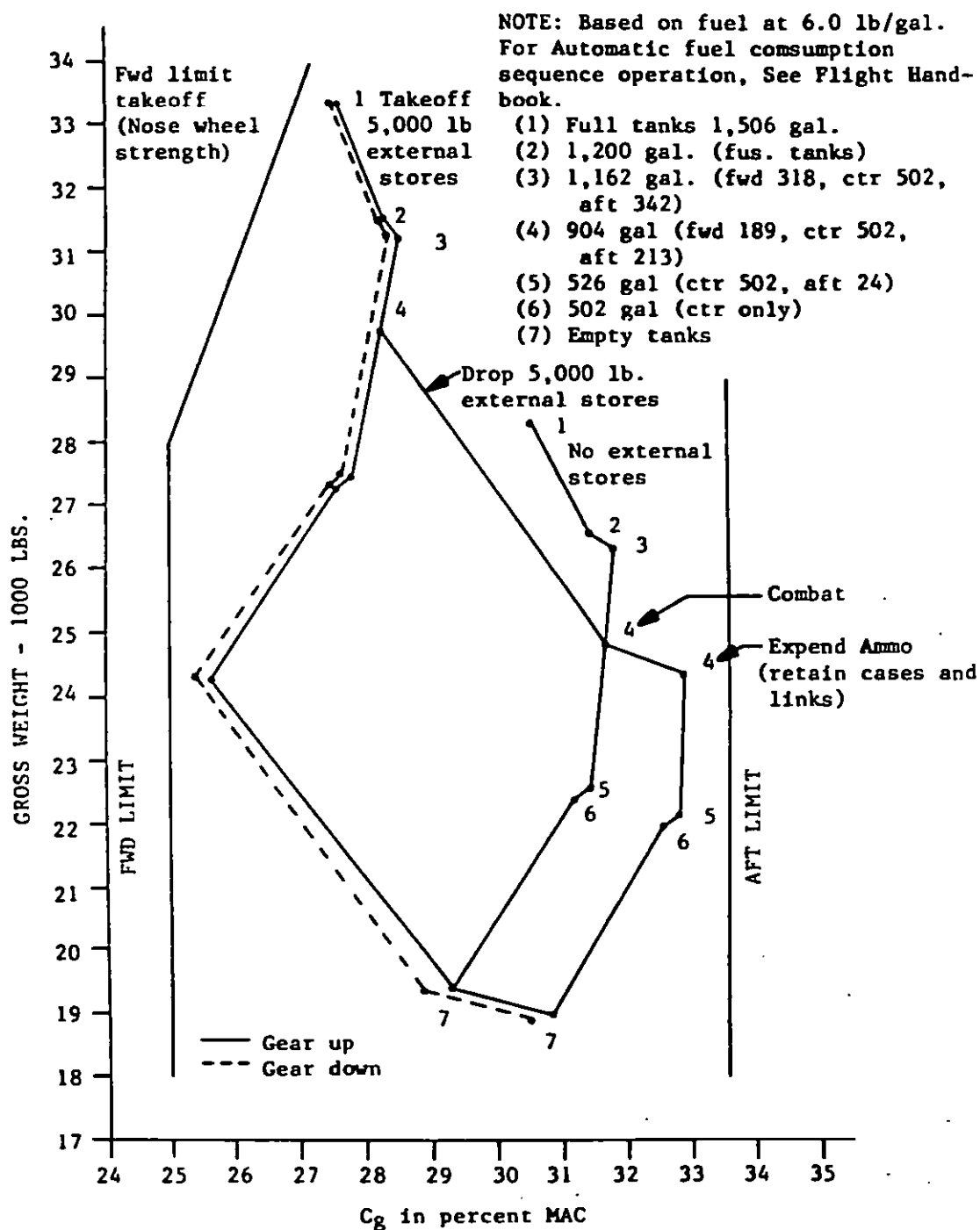


FIGURE 3. Sample center of gravity envelope diagram.

(8) Centerlines of engine mounting points.

(9) Lengths, depths, and widths for body, nacelles, booms, and floats to identify the extent of the areas listed in the Group Weight Statement.

(10) Crosshatching of the outlines of wing and tail gross areas blanketed by the body, to identify the extent of the areas listed in the Group Weight Statement.

(11) For rotorcraft, an outline sketch of the transmission system, showing shafting and gearboxes from the engine through the system to the rotors, with design horsepower, torques, and gear ratios noted thereon for both 1/2 hour and continuous ratings.

3.7.3 Calculated Weight Report. This report shall be submitted for preproduction contracts approximately midway between the stages of design represented by the Estimated Weight Report and the first Actual Weight Report and for production contracts as soon as practicable after the contract has been awarded, but not later than 30 days after the design phase represented by the report. When Weight and Balance Status Reports are required, the Calculated Weight Report shall be coordinated with the current weight status and c.g. in the current status report, and the applicable status report shall be referenced by number, date, and title. Weights shown in this report shall be as accurate and as complete as possible with the information available. The following data shall be included in the report in the order shown:

a. A table summarizing the weight, moments of inertia and c.g. (horizontal, lateral and vertical) data for the weight empty and all gross weight conditions covered in the balance calculations. Dimensional data (suitably illustrated by a small profile sketch of the aircraft) locating the horizontal and vertical moment axes, and MAC or main rotor centerline, and reference to the applicable Weight and Balance Status Report shall be given below the table. The recommended c.g. limits shall be shown on, or tabulated below, the profile sketch. Refer to paragraph 3.7.1(b).

b. Group Weight Statement: (MIL-STD-1374, Part I).

c. Detail Weight Statement: (MIL-STD-1374, Part II).

d. The following weight and balance calculations
(Refer to Section 3.8):

(1) Weight empty detail balance calculations
(including alternate lighting gear).

MIL-W-25140B

(2) Gross weight balance calculations for all loading conditions listed in the aircraft contract detail specification, and for the most forward and the most aft loading conditions attainable. When an aircraft can be operated with more than one type of fuel, data shall be included for all types.

(3) Derivation of the moment change owing to retracting the alighting gear.

(4) Weight, arm, and moment data for all alternate or special load items for which provision is made, and the affect on the primary or other applicable load condition.

e. Center of Gravity Envelope diagram showing a plot of weight vs c.g. similar to Figure 3 for all loading conditions listed in the specifications and for the most forward and aft loading conditions attainable, to illustrate the effect of expendable and variable items of useful load and alighting gear retraction.

f. A tabulation of specified and current weights of all GFAE included in the weight empty and determination of the net under or overweight of this equipment, and a separate tabulation of similar data for GFAE included in the useful load. All changes in the list as given in the original contract specification for the aircraft shall be explained by suitable comment and reference to change orders, ECP's, etc.

g. A tabulation of all authorized changes included in the reported weight empty and useful load, the weights and the groups to which the weights are allocated. Pending changes which have been incorporated shall also be listed separately. Changes shall be identified by the contract change letter, or change order number, designations, and by subject. Correspondence references or ECP numbers may be used for pending changes.

h. A tabulation deriving the contractor responsibility weight empty under or overweight, as follows:

- (1) The original contract/guaranteed weight empty.
- (2) The weight empty increases or decreases owing to the weights of (a) authorized changes, (b) pending changes, and (c) the net under or overweight of GFAE.
- (3) The original contract/guaranteed weight empty as modified by (2) above.
- (4) Comparison of the calculated weight empty with the revised contract/guaranteed weight empty derived in (3), to obtain the contractor responsibility under or overweight.

MIL-W-25140B

1. Structural diagrams, corrected to date.

j. For production aircraft, a summary of changes and weight and balance differences over the prototype aircraft. When Weight and Balance Status Reports are not required, include information on any anticipated change in recommended c.g. limits, with reference to the source of the recommended limits, brief indication of the critical flying qualities or structural considerations which dictated these limits, and reasons for any tapered or special c.g. restrictions.

3.7.4 Actual Weight Report - First Aircraft. This report shall be submitted not later than 45 days after the aircraft is weighed, except that if the aircraft is assigned for test purposes, the report shall in no case be submitted later than the time of delivery to the testing activity. The following data shall be included in the report in the order shown:

a. Serial numbers of the aircraft for which this report is considered to be representative.

b. A table summarizing the weight, moments of inertia and c.g. (horizontal, lateral and vertical) data for the weight empty and all gross weight conditions covered in the balance calculations. Dimensional data (suitably illustrated by a small profile sketch of the aircraft) locating the horizontal and vertical moment axes, and MAC or main rotor centerline, shall be given below the table.

c. Group Weight Statement: (MIL-STD-1374, Part I).

d. Detail Weight Statement: (MIL-STD-1374, Part II).

e. Weighing Form: An approved weighing form, and when specifically requested by the procuring activity, Form AN-9250.

f. A detailed list of the items, weights, arms, and moments to be added to or subtracted from the as weighed condition to arrive at the weight empty data. A separate list of items, weights, arms, and moments shall be made for any test equipment or ballast installed in the aircraft at the time of weighing. For classes 1B and 2 aircraft, a separate list of items, weights, arms and moments added to the weight empty data to arrive at the basic weight moment shown in the Weight Handbook. Footnotes, including applicable letter references, shall call attention to any weight empty items authorized to be omitted at delivery, or temporarily omitted because of shortages or other reasons.

MIL-W-25140B

g. All weight and balance calculations (refer to Section 3.8) from the Calculated Weight Report, corrected to agree with actual weight and c.g. data. Calculations for the alternate conditions not covered by the weighing shall be based on the results of actual weighing of the alternate alighting gear components, if available, or the alternate alighting gear data shall be identified as estimated or calculated. For seaplanes, the weights, arms, and moments for main and auxiliary beaching gear, as installed during a weighing, shall also be listed. Label data "calculated" if actual weights are not available. All calculations shall be given in at least as much detail as in the Calculated Weight Report. Actual weights shall be used for all contractor-furnished items and for the Government-furnished items installed by the contractor. Nominal (specified) weights shall be used for all other Government-furnished items.

h. Center of Gravity Envelope diagram showing a plot of weight vs c.g., similar to Figure 3 for all loading conditions listed in the specifications and for the most forward and aft loading condition attainable, to illustrate the effect of expendable and variable items of useful load and alighting gear retraction.

i. A tabulation of specified and actual weights of all GFAE included in the weight empty based on weighings of the items of equipment prior to installation in the first aircraft, and determination of the net under or overweight of this equipment. A separate tabulation of similar data for GFAE included in the useful load. All changes in the list as given in the original contract specification for the aircraft shall be explained by suitable comment and reference to change orders, ECP's, etc.

j. A tabulation of all authorized changes included in the reported weight empty and useful load, the weights, and the groups to which the weights are allocated. Pending changes which have been incorporated shall also be listed separately. Changes shall be identified by the contract change letter, or change order number, designations, and by subject. Correspondence references or ECP numbers may be used for pending changes.

k. A tabulation deriving the contractor responsibility weight empty under or overweight, as follows:

- (1) The original contract/guaranteed weight empty.
- (2) The weight empty increases or decreases owing to the weights of (a) authorized changes, (b) pending changes, and (c) the net under or overweight of GFAE.
- (3) The original contract/guaranteed weight empty as modified by (2) above.
- (4) Comparison of the actual weight empty with the revised contract/guaranteed weight empty derived in (3), to obtain the contractor responsibility under or overweight.

1. Unusable fuel and oil data as specified herein.

MIL-W-25140B

m. Structural diagrams, corrected to date.

n. The Weight Handbook, including weighing form, Charts A, C, and E, (and Form DD-365F for class 2 aircraft). Chart A shall be checked to show the inventory applicable to the basic weight data derived in the report and entered in Chart C.

o. When the Weight Handbook is not required, information on:

(1) The type and location of leveling device and the means provided for taking measurements during weighings, in descriptive or diagrammatic form.

(2) The c.g. limits recommended by the contractor. For rotorcraft, if necessary, calculations shall be included converting limits in terms of inches from centerline of rotor to limits in terms of inches from reference datum.

3.7.5 Actual Weight Report - Intermediate Aircraft. This report shall be submitted not later than 45 days after the aircraft is weighed, except that if the aircraft is assigned for test purposes, the report shall in no case be submitted later than the time of delivery to the testing activity. The following data shall be included in the report in the order shown:

a. Serial numbers of the aircraft for which this report is considered to be representative.

b. A table summarizing the weight and horizontal c.g. data for the weight empty and the primary gross weight condition. (When changes are incorporated which materially affect vertical c.g. data submitted in a previous report, the weights, arms, and moments for the changes and their effect on the vertical c.g. shall be included in the balance calculations and in the summary.) Include lateral calculation when required.

c. Group Weight Statement: (MIL-STD-1374, Part I).

d. Detail Weight Statement (MIL-STD-1374, Part II) when required by the applicable Data Item Description (DID).

e. Weighing Form: An approved weighing form, and when specifically requested by the procuring activity, Form AN-9250.

f. A detailed list of the items, weights, arms, and moments to be added to or subtracted from the as-weighed condition to arrive at the weight empty data when required. For classes 1B and 2 aircraft a separate list of items, weights, arms, and moments added to weight empty data to arrive at the basic weight and moment shown in the Weight Handbook, when required. Footnotes, including applicable letter references, shall call attention to any weight empty items authorized to be omitted at delivery or temporarily omitted because of shortages or other reasons.

MIL-W-25140B

g. The following weight and horizontal balance calculations (Refer to Section 3.8):

(1) Primary gross weight condition, based on the useful load in the last previous Actual Weight Report, corrected for changes incorporated.

(2) The alternate conditions not covered by the weighing. Calculations shall be based on the actual weighing of the aircraft and the latest information for the alternate alighting gear.

(3) Any additions or revisions to alternate or special load items, and effect on the primary or other applicable load condition, because of changes incorporated since the last previous Actual Weight Report.

h. A tabulation of all changes from the list of actual and specified weights of all items of GFAE included in the weight empty, as given in the last previous Actual Weight Report, and determination of the net under or overweight of this equipment, and a separate tabulation of similar data for changes in the list of GFAE in the useful load. Changes shall be explained by suitable comment and reference to change orders, ECP's, etc.

i. A tabulation of all authorized changes included in the weight empty and useful load subsequent to the last previous Actual Weight Report, the weights and the groups to which the weights are allocated. Pending changes which have been incorporated shall also be listed separately. Changes shall be identified by the contract change letter, or change order number, designations, and by subject. Correspondence references or ECP numbers may be used for pending changes.

j. A tabulation deriving the contractor responsibility weight empty, under or overweight, as follows:

(1) The original contract/guaranteed weight empty.

(2) The weight empty increases or decreases owing to the weights of (a) authorized changes, (b) pending changes, and (c) the net under or overweight of GFAE.

(3) The original contract/guaranteed weight empty as modified by (2) above.

(4) Comparison of the actual weight empty with the revised contract/guaranteed weight empty derived in (3), to obtain the contractor responsibility under or overweight.

MIL-W-25140B

k. A tabulation of all actual changes in weight empty and useful load over the last previous Actual Weight Report, with weight distribution shown by groups, together with applicable references to authorized changes, contractor design changes, etc. The "manufacturing variation" shall also be listed. If the weight empty c.g. shift since the last previous Actual Weight Report exceeds 0.5 percent MAC for aircraft or 0.5 inch for rotorcraft, the moments caused by the changes and the unaccountable moment shall also be listed. If the cumulative weight empty c.g. shift since the first aircraft report, or since the last report in which the moments were listed, exceeds 1 percent MAC for aircraft or 1.0 inch for rotorcraft, similar moment data shall be furnished to account for the cumulative shift.

l. Unusable fuel and oil data as specified herein if a change in the fuel or oil systems has been made which materially affects the data previously determined.

m. Structural diagrams if the diagrams furnished in a previous report are modified because of changes incorporated.

n. The Weight Handbook, including weighing form, Charts A, C, and E (and Form DD-365F for class 2 aircraft). Chart A shall be checked to show the inventory applicable to the basic weight data derived in the report and entered in Chart C.

3.7.6 Appendices to Actual Weight Reports required prior to conducting procuring activity tests. These appendices are required only for Actual Weight Reports representative of one or more preproduction aircraft, or production blocks, from which any aircraft are allocated for procuring activity tests (for Navy, Parts II and III demonstrations and the trials). The appendices shall be submitted no later than the time of delivery of the aircraft to the testing activity.

3.7.6.1 Appendix to Actual Weight Report representative of the block. The following data shall be included:

a. A detailed tabulation of all modifications incorporated by the contractor subsequent to the basic report and prior to the delivery of the aircraft for tests, including effectivity points if not applicable to all aircraft of the block.

b. The effect of the modifications on actual and contract/ guaranteed weight and balance, contractor responsibility under or overweight, useful load, and extreme c.g. conditions. When pending changes have been included in under or overweight determination in the basic report, data shall be furnished to correct the tabulations to agree with the pending changes as finally authorized, including any necessary revisions to the under or overweight of GPAE.

c. Because of the above changes, revised pages of (or revisions to) the Weight Handbook data are required for all classes of aircraft.

MIL-W-25140B

3.7.6.2 Appendix for instrumented aircraft. This appendix is required only for instrumented aircraft (for Navy applications, only for those instrumented aircraft allocated for structural, aerodynamic, and carrier suitability phases of the Parts II and III demonstrations and the trials). This appendix is considered as "Formal Data". Acceptance or approval by the procuring activity is required for this appendix. It shall include sufficient information to enable the testing activity to determine the actual as-delivered weight and balance of the aircraft and to assist in simulating loadings for test purposes. The following information shall be included:

- a. Serial number of the aircraft, and test purpose(s) to which assigned.
- b. Reference to the Actual Weight Reports for the block(s) from which the test aircraft were selected and which can be used as a reference source for representative weight and balance data for the "specification configuration."
- c. Weighing Form: An approved weighing form, and when specifically requested by the procuring activity, Form AN-9250.
- d. List of weight and balance corrections, if necessary, to reflect any changes between the actual weighing and the actual as-delivered condition.
- e. Tabulations furnishing weight, arm, and moment data on the following, sufficiently detailed to enable test activity personnel to identify all components on board the aircraft as delivered:
 - (1) Test equipment.
 - (2) Ballast, including information indicating its function (simulation of specific missing equipment, over-all simulation of gross weights and c.g.'s, etc).
 - (3) Supplementary data as may be considered necessary by the contractor to show removal or addition of ballast or equipment to achieve the extremes of gross weight and forward and aft c.g., or loading combinations expected to be simulated on the instrumented aircraft during procuring activity tests (assuming, also, sufficient fuel for conducting the tests).
- f. List of "specification configuration" equipment missing from the instrumented aircraft.

MIL-W-25140B

3.7.7 Final appendices to Actual Weight Reports. These appendices are required only for Actual Weight Reports representative of blocks from which any aircraft have been allocated for procuring activity tests (for Navy, Parts II and III demonstrations and trials), and shall be submitted not later than 45 days after completion of tests. The data required for appendices in 3.7.6.1 shall be brought up to date to reflect all modifications incorporated and flight test changes found necessary for acceptance of the aircraft up to the time of completion of the tests.

3.7.8 Actual Weight Report - Last Aircraft. This report shall be submitted not later than 45 days after the aircraft is weighed, except that if the aircraft is assigned for test purposes the report shall in no case be submitted later than the time of delivery to the testing activity. The following data shall be included in the report in the order shown:

- a. Serial numbers of the aircraft for which this report is considered to be representative.
- b. A table summarizing the weight, moments of inertia and c.g. (horizontal, lateral and vertical) data for the weight empty and all gross weight conditions covered in the balance calculations. Dimensional data (suitably illustrated by a small profile sketch of the airplane) locating the horizontal and vertical moment axes, and MAC or main rotor centerline shall be given below the table.
- c. Group Weight Statement: (MIL-STD-1374, Part I).
- d. Detailed Weight Statement: (MIL-STD-1374, Part II).
- e. Weighing Form: An approved weighing form, and when specifically requested by the procuring activity, Form AN-9250.
- f. A detailed list of items, weights, arms, and moments to be added to or subtracted from the as-weighed condition to arrive at the weight empty data when required. For classes 1B and 2 aircraft, a separate list of items, weights, arms, and moments added to the weight empty data to arrive at the basic weight and moment shown in the Weight Handbook, when required. Footnotes, including applicable letter references, shall call attention to any weight empty items authorized to be omitted at delivery or temporarily omitted because of shortages or other reasons.
- g. All weight and balance calculations (refer to Section 3.8) similar to those furnished in the Actual Weight Report - First Aircraft corrected to agree with the weight and c.g. of the last aircraft and including all changes in the useful load and alternate or special load items. Calculations for the alternate conditions not covered by the weighing shall be based on the results of actual weighing of the alternate alighting gear.

MIL-W-25140B

h. Center of Gravity Envelope diagram showing a plot of weight vs c.g., similar to Figure 3 for all loading conditions listed in the specifications and for the most forward and aft loading condition attainable, to illustrate the effect of expendable and variable items of useful load and alighting gear retraction.

i. A tabulation of all changes from the list of actual and specified weights of all items of GFAE included in the weight empty, as given in the last previous Actual Weight Report, and determination of the net under or overweight of this equipment. A separate tabulation of similar data for changes in the list of GFAE included in the useful load. Changes shall be explained by suitable comment and reference to change order, ECP's, etc.

j. A tabulation of all authorized changes included in the weight empty and useful load subsequent to the last previous Actual Weight Report, the weights and the groups to which the weights are allocated. Pending changes which have been incorporated shall also be listed separately. Changes shall be identified by the contract change letter, or change order number, designations, and by subject. Correspondence references or ECP numbers may be used for pending changes.

k. A tabulation showing the contractor responsibility weight empty under or overweight, as follows:

- (1) The original contract/guaranteed weight empty.
- (2) The weight empty increases or decreases owing to the weights of (a) authorized changes, (b) pending changes, and (c) the net under or overweight of GFAE.
- (3) The original contract/guaranteed weight empty as modified by (2) above.
- (4) Comparison of the actual weight empty with the revised contract/guaranteed weight empty derived in (3), to obtain the contractor responsibility under or overweight.

1. A tabulation of all actual changes in weight empty and useful load over the last previous Actual Weight Report, with weight distribution shown by groups, together with applicable references to authorized changes, contractor design changes, etc. The "manufacturing variation" shall also be listed. If the weight empty c.g. shift since the last previous Actual Weight Report exceeds 0.5 percent MAC for aircraft or 0.5 inch for rotorcraft, the moments caused by the changes and the unaccountable moment shall also be listed. If the cumulative weight empty c.g. shift since the first aircraft report, or since the last report in which the moments were listed, exceeds 1 percent MAC for aircraft or 1.0 inch for rotorcraft, similar moment data shall be furnished to account for the cumulative shift.

m. Unusable fuel and oil data as specified herein if a change in the fuel and oil systems has been made which materially affects the data previously determined.

n. Complete set of updated structural diagrams.

o. The Weight Handbook, including weighing form, Charts A, C, and E (and Form DD-365F for class 2 aircraft). Chart A shall be checked to show the inventory applicable to the basic weight data derived in the report and entered in Chart C.

3.7.9 Handbook, Weight and Balance Data, (classes 1B and 2 aircraft). The contractor shall prepare and reproduce charts and complete the Weight Handbook for each aircraft in accordance with the instructions given herein. (For Air Force contracts further information may be found in T.O. 1-1B-50 and MIL-M-5920.)

3.7.9.1 General. The following general instructions apply:

a. Insert all aircraft identifying data on the title page and the various charts and forms.

b. All moment data entered in the handbook shall be divided by the constant 1,000. A constant of 100 for extremely small aircraft, or 10,000 for extremely large aircraft, may be used subject to prior approval by the procuring activity. Wherever "moment" is referred to in the following instructions to the contractor for preparation of chart data, it shall be understood to mean "moment/constant."

c. Each Weight Handbook shall represent the as-delivered condition of the aircraft for which it is prepared, and include a sample Form DD-365F for class 2 aircraft. Subject to specific approval of the procuring activity in each case and dependent upon the rate of production, handbooks for class 1B aircraft may be prepared for groups of identical aircraft. In the latter case, the basic weight and moment shall be based on actual data applicable to the group and on an assumed primary operating condition, with the "Delivery Equipment" column on Chart A dated above the column to agree with the Chart C entry, and checked to agree with the equipment in the assumed condition; a copy of Figure 4 shall be inserted in the front of the handbook of each aircraft of the group, and the contractor, or the activity responsible for loading for flyaway delivery, shall insure that all aircraft are properly loaded for such flyaway delivery.

d. The contractor shall assign and place the date of preparation (or revision) in an inconspicuous location on each page of the charts (e.g., in the binding margin, etc.) Charts A and E shall conform to a page size of 8-1/2 by 11 inches, including approximately 1-inch space allowance for binding, and the following in the upper outer corner of all pages of the respective charts:

MIL-W-25140B

IMPORTANT NOTICE

Subj: Handbook of Weight and Balance Data for Model
 Aircraft, Basic Weight Data for.

1. The basic weight data entered in Chart C of the Weight Handbook of this aircraft applies to an assumed primary operating condition. The "Delivery Equipment" column in Chart A has been checked to show the equipment included in the basic weight for this assumed condition and, therefore, does not necessarily represent the equipment actually installed in this aircraft.
2. The weight and balance personnel of the activity receiving this aircraft shall correct the basic weight to agree with the actual operating condition of the aircraft in accordance with the following instructions:
 - (a) After installation of the required equipment conduct a Chart A inventory in the "Check 1" Column.
 - (b) Compare this inventory with that for the basic weight entry in Chart C. Correct the Chart C entry as necessary for any items of equipment which have been added or removed.
3. After completion of the above, this sheet shall be removed from the handbook.

FIGURE 4. Notice to be inserted in the Weight Handbook when an assumed primary operating basic weight condition is entered on Chart C.

MIL-W-25140B

On Chart A:

Chart Date - See Page 1

On Chart E:

Page _____ of _____

Model _____

Chart Date - See Page 1

On page 1 of Charts A and E, the words "See Page 1" shall be replaced by the most recent date of the individual preparation or revision dates of the pages comprising that chart.

e. Chart E shall be inserted immediately after the Chart C pages.

f. The instruction book furnished with each balance computer shall be inserted at the end of Section III.

g. In no case shall an item be listed on both Charts A and E.

3.7.9.2 Chart A, Form DD-365A. Instructions for the preparation of Chart A are furnished below:

a. Operating equipment which is or may be installed and for which provision or fixed stowage has been made shall be listed on Chart A as separate items, or groups of inseparable items, suitably identified in order to facilitate an inventory of equipment by inexperienced personnel. If an item can be in a "stowed" and an "installed" location, the item shall be listed for both locations and so labeled. All items weighing 2 pounds or more shall be listed for aircraft whose weight empty is under 25,000 pounds, and items weighing 5 pounds or more, for larger aircraft. Figure 5 furnishes a list of various items to consider for Chart A.

b. 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 list of equipment items for one compartment. The compartment designation shall be underlined and separated from the equipment list by one blank line. The limits of each compartment in inches from the reference datum shall be placed on same line as the compartment designation. These compartment limits shall agree with those shown on Chart E. Equipment located external to the body compartments, e.g., in wings, nacelles, etc, shall be listed at the end of Chart A under appropriate designations. When required by the procuring agency, sketches of Chart A item locations will be inserted as a facing page to the corresponding items listing as shown in Figure 5 (Sheet 4 of 4).

MIL-W-25140B

The following list, representative of types of items which should be tabulated on Chart A, includes equipments which normally have a fixed location and which might be in or out of the aircraft during weighing or for various operating configurations. Items should be listed on Chart A only if they weigh 2 pounds or more for aircraft under 25,000 pounds weight empty and weigh 5 pounds or more for larger aircraft. Items should be listed by descriptive name or type, part number or equipment designation, quantity, capacity, and other appropriate means to avoid ambiguity and to facilitate identification and inventory by personnel who may not be thoroughly familiar with the aircraft. Equipments which are alternates to each other shall be suitably identified, e.g., "(alternate to item A-21)" or similar.

A. Alternate or operating equipment:

1. Autopilot removable components.
2. Electrical power supply, e.g., batteries, generators, inverters, etc.
3. Air intake filters.
4. Water injection tanks.
5. Engines and propellers when alternate installations are provided or when weight variations encountered materially affect aircraft weight and center of gravity.
6. Hydraulic fluid over normal system capacity.
7. Hand cranks if not built in.
8. Pneumatic bottles for operating mechanisms.
9. Removable main and auxiliary fuel and oil tanks and tanks which are droppable only in emergencies. Tanks normally dropped during the mission should be listed on Chart E.
10. Fuel vapor inertion generators or cylinders.
11. Anchor gear.
12. Permanent ballast.
13. Catapult and arresting hooks and arresting hook point.
14. Portable bilge pump and hose.
15. Unusable fuel and unusable oil.
16. Auxiliary power unit.
17. Windshield wipers and washer or anti-icing fluid.
18. Alternate alighting gears.
19. Mooring gear, covers, etc.
20. Ladders and platforms.
21. Tool kits.

FIGURE 5 (Sheet 1 of 4). Typical items to be listed on Chart A.

MIL-W-2514C9

B. Crew safety and comfort equipment not integral with structure:

1. Heating, cooling, and pressurizing equipment and insulation, e.g., heaters, heat exchangers, blowers, etc.
2. Oxygen equipment, e.g., generators, cylinders, weight of contents, regulators, etc.
3. Parachutes if fixed stowage provided. When no fixed stowage is provided and parachute is worn by crew member in flight, include in crew weight on Chart E.
4. Life rafts and emergency equipment stowed with rafts. When individual rafts are attached to parachute pack and worn by crew member in flight, list on Chart E.
5. Crew seats, safety belts, bunks, beds, cushions, tables, mirrors, etc. For ejection seats, list ejectable portion of seat and state items included.
6. Lavatory and toilet facilities.
7. Curtains.
8. Anti-icing removable components, e.g., boots and attaching parts, heaters, tanks, fluid.
9. Flares, tubes, signal pistols and ammunition, and other pyrotechnic equipment. When the quantity of flares materially affects aircraft weight and center of gravity, list on Chart E.
10. Navigation equipment, e.g., driftsight, navigational kit or packet, sextant, astrocompass, etc.
11. Fire extinguisher cylinders.
12. Emergency axes, first aid kits, etc.
13. Blind flying hood.
14. Electronic equipment, e.g., receivers, transmitters, dynamotors, antennas, etc. Mounts shall be listed separately.

C. Protection:

1. Removable armor and deflector plate.
2. Removable bullet resistant glass.

D. Armament installations:

1. Guns, chargers, blast tubes, sights, and removable mounts.
2. Ammunition boxes, chutes, boosters.
3. Turrets.
4. Gun cameras.

FIGURE 5 (Sheet 2 of 4). Typical items to be listed on Chart A.

MIL-W-25140B

5. Racks, shackles, adapters, pylons, etc., for stores, rockets, etc. When these items are a variable with the stores carried, list on Chart E with appropriate explanatory information.
6. Bomb sight.
7. Electronic equipment.

E. Personnel and cargo transport equipment:

1. Troop and passenger seats and belts.
2. Tables.
3. Window curtains, rods, rugs, removable soundproofing and insulation, and other interior furnishings.
4. Food and drink containers. List contents separately.
5. Stoves, hot plates, refrigerators.
6. Utensils and tableware (stowed location).
7. Cup containers.
8. Litters and supports. List stowed and installed locations.
9. Tie down gear (stowed location).
10. Special floors.
11. Ramps.
12. Hoists, winches, monorails, dollies.

F. Photographic equipment for photographic aircraft:

1. Removable components providing for camera installations, e.g., intervalometers, mounts normally carried at all times, etc. Camera, magazines, film, flashbombs, hatches, and mounts variable with the camera installation shall be listed on Chart E.

FIGURE 5 (Sheet 3 of 4). Typical items to be listed on Chart A.

CD 365A

33

c. The order in which items are listed shall be, insofar as is practicable, such that the moment arms increase progressively from the forward limit to the aft limit of the 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 c.g. of the item or group falls within the limits of the compartment. Items shall be numbered consecutively by compartments, e.g., items in compartment A shall be designated A-1, A-2, A-3, etc.

d. Unusable and trapped fuel and oil (weights, arms, and moments) shall be listed as two separate items, and the drain points identified by suitable notes such as "when drained in normal ground attitude from (identity of drain point)." When "unusable" and "trapped" fuel and oil are different, this entry will be so noted and the difference shall be shown on the fuel and/or oil pages in the Chart E's and a note in the weighing instruction concerning this difference shall be placed therein.

e. For convertible aircraft with alternate alighting gear, data shall be listed for the alternate alighting gear conditions, if materially different, and "in normal beaching gear attitude" or similar expression used where appropriate.

f. Weights and moments shall be listed to the nearest whole number, and the arms shall be listed to one decimal place.

3.7.9.3 Weighing form, Form DD-365B. The contractual weighing schedule provides for weighing certain aircraft during the contract. The data from these weighings shall be utilized in preparing weighing forms for the Weight Handbook. For those aircraft not actually weighed, the weighing data for the weighed aircraft of the same production block shall be used and a note added in the "Remarks" block, "Based on the actual weighing of aircraft serial No. _____." Since this procedure presupposes identical aircraft with normal production tolerances on weight and c.g., any known differences shall be accounted for in determining the basic weight for aircraft not actually weighed.

3.7.9.4 Chart C, Form DD-365C. The as-delivered basic weight, and moment (alighting gear extended) and, where applicable, the balance computer index, shall be listed. The "assumed primary operating condition" basic weight data shall be entered when the deviation permitted by 3.7.9.1c is authorized. If the "assumed primary operating condition" includes the weight of any shortage items which are not listed normally on Chart A as inventory items, these items shall be listed as Chart C entries to avoid confusion when the items are subsequently installed in service. The date and data entered on Chart C shall agree with the date and inventory marks entered in the "Delivery Equipment" column on Chart A.

3.7.9.5 Chart E. Chart E shall provide means for determining quickly and accurately the horizontal c.g. position of the aircraft under any loading condition. When loading limitations or cautions are necessary to avoid adverse lateral load distribution, pertinent information shall be included in the appropriate tables. The requirements specified herein shall be regarded as minimum, and the contractor shall include such additional data as may be deemed necessary to insure that Chart E will fulfill adequately its intended purposes. Data shall be presented in the form of tables, and in the order listed below insofar as practicable consistent with space arrangement and use of minimum number of pages. Weight and moment data shall be listed to the nearest whole number. Arms shall be listed to one decimal place. For sample data, see Figures 6 through 21, inserted where applicable (see Numerical Index).

3.7.9.5.1 Weighing instructions. These data shall present any special weighing instructions or information which are peculiar to the individual aircraft and which are necessary for field weighing personnel who are unfamiliar with these aircraft, to reproduce with reasonable accuracy the conditions necessary for determining the basic weight. (It is not intended that general weighing preparation and techniques be described.) The weighing instructions shall also include a required weighing frequency for the aircraft that has been determined by consultations between the contractor and the procuring activity. Other typical items are as follows:

a. Open or closed, retracted or extended position of sliding nose compartment cowl, canopy, slats, leading or trailing edge flaps, etc., if they would individually or cumulatively materially affect basic weight c.g. Give moment/constant correction if weighed with item in opposite position.

b. Cautions pertaining to draining of water from bilges of seaplanes or amphibians before weighing.

c. Brief defueling and oil drainage instructions, if it is necessary to prescribe a defueling procedure to accomplish a known condition of drainage in ground attitude (i.e., "trapped" fuel and oil aboard). Such procedures may involve a given sequence of defueling, transfer from certain tanks using boost pumps where single point defueling is provided, maintenance of certain suction pressures on defueling pumps, etc. In addition, where "trapped" and "unusable" fuel and oil and materially different quantities, the following notes shall be completed and included in the instructions:

MIL-W-25140B

WEIGHING INSTRUCTIONS

1. Aircraft Condition
 - A. The basic weight condition is established with wheels down, a/lats extended, and with the nose cone and canopy closed. If weighed with the nose cone open, the moment/1,000 correction is minus (-) 4.8. If weighed with the canopy open, the moment/1,000 correction is minus (-) 3.3.
2. Fuel Draining
 - A. Operate boost pumps in forward fuselage and aft center section tanks. Check "no flow transfer" warning light in cockpit to insure that transfer system is empty.
 - B. Defuel in three-point attitude through pressure fueling and defueling valve located on bottom centerline of the aircraft at station 272.5 using the external defueling pump. Do not open water drains in lines or fuel strainers. Caution: Aft fuselage tank drains by gravity into the main fuselage tank and thence to the defueling valve. Special care must be taken to insure that the aft fuselage tank is fully drained as follows:
 - (1) If using the self-priming pump, allow pump to run for 5 minutes after flow initially stops to make sure that gravity flow from aft fuselage tank is completed.
 - (2) If using the non-self-priming pump, limit pump suction to a pressure of 1.0 psi to keep pumping rate below gravity flow rate aft fuselage tank, thus avoiding loss of pump prime before aft fuselage tank is drained.
 - C. Fuel remaining aboard after defueling in the above manner is the unusable fuel included in aircraft basic weight (see Chart A for quantity).
3. Leveling
 - A. Plumb bob leveling suspension fitting and target are located in the nose gear bay on the upper and lower longerons on the LH side. See detail on page 2.
 - B. To reduce the large aircraft ground angle for ease in leveling, blow up the main gear struts to fully extended position; deflate and tie the nose gear strut in fully compressed position.
 - C. Center the nose wheels and make sure that they are free to roll on the floor when the wing jacks are extended. Place standard jacks under the wing jack pads and raise aircraft until approximately level. (Electric weighing cells must never be on the jacks for this operation.)
 - D. Shore up main wheels with wooden cribbing. Lower wing jacks until aircraft again rests on wheels.
 - E. Place electric weighing cells on jack at forward fuselage jack point and on wing jacks. Raise jack until wheels are clear, leveling aircraft with jacks.
 - F. Alternate to item C and D above: Raise aircraft with overhead hoist until approximately level. Proceed with item E.
 - G. When weighing on wheels with mechanical scales, raise aircraft by method C or F until slightly nose down in attitude; then, if necessary, use jack at forward fuselage jack point in order that the scale may be inserted under nose wheels. Shore up main wheels with cribbing on top of scales until aircraft is almost level with wheels resting on the cribbing; bleed main gear struts as required for the final level adjustment.
4. Measuring
 - A. The "jig point" is the forward fuselage jack point, fuselage structural station 266.09. See detail on page 2. Caution: Do not confuse the jack point socket with the boresighting fixture socket located a few inches farther forward in the nose gear bay.
 - B. For "letter" dimensions referred to below, see the diagram on page 2.
 - C. When weighing on jack points, actual measurements during weighing are not necessary. After leveling, the following dimensions for "E" and "F" may be inserted directly in the weighing form:

| | |
|---|--------------------|
| (Wing) Aft jack point to reference datum. | Dimension E=422.54 |
| (Fuselage) Forward jack point to reference datum. | Dimension F=266.09 |
 - D. When weighing on wheels, measure dimensions "B" and "D" during weighing and after leveling. Using these actual dimensions and the jig point dimension "I", determine "E" and "F". For checking purposes, approximate dimensions "E" and "F" are given in the table on page 2.

FIGURE 6. Sample weighing instructions.

"The Basic Weight is established with 'unusable' fuel and oil (equivalent to the zero point of the gages). If the aircraft is weighed after draining fuel and oil in normal ground attitude as outlined above, the following increments shall be (added) (subtracted) to the 'as-weighed' condition to obtain the Basic Weight:

| Item | Weight | Moment/constant |
|-------------|--------|-----------------|
| Fuel Oil | | |

If the aircraft is weighed with completely dry fuel and oil systems, the 'unusable fuel' and 'unusable oil' weight and moment listed on Chart A shall be added to the 'as-weighed' condition to obtain the Basic Weight."

d. Suggested procedure for leveling if the normal ground attitude or alighting gear arrangement is such that placing the aircraft in level attitude for weighing might entail unusual problems for field personnel. In this category are aircraft which have extremely long nose gear struts and require extreme rotation of attitude, aircraft with bicycle gear which might require a sequence of steps of jacking, using several sets of jack points, etc. Include brief statement of recommended shock strut inflation or deflation, approximate height main or nose wheels must be raised, lift points available for hoisting to level position, any cautions considered necessary, etc.

e. Measuring data, if descriptive instructions are necessary for specific location and positive identification of jig points.

f. Sketches, tables, etc., when necessary, to amplify the weighing information required for the aircraft diagram.

g. For aircraft which may be weighed on removable beaching gear, list "dry weights" of beaching gear, moment arms, and moment/constant for use in correcting "as weighed" to Basic Weight. If dry weight varies sufficiently to affect the accuracy of the weighing, add a note: "Approximate. See actual weights stenciled on beaching gear."

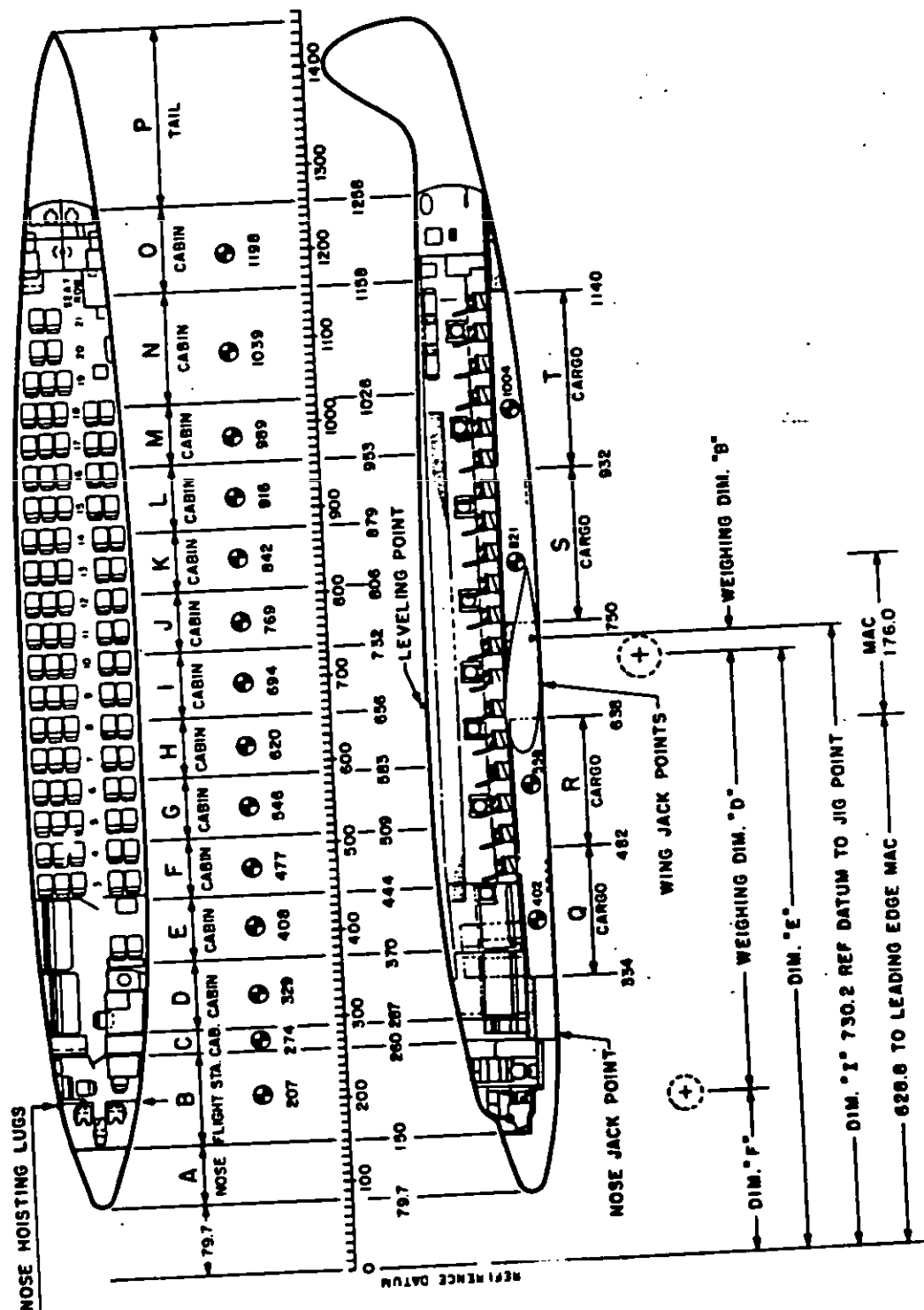
3.7.9.5.2 Aircraft diagram. The aircraft diagram shall consist of a side elevation of the aircraft and a plan view of the body and one wing showing the data listed below. The wing diagram may be broken off outboard of the point required to show wing equipment and loading installations. Alternate alighting gears shall be represented by separate diagrams if necessary for clarity.

MIL-W-25140B

- a. Reference datum.
- b. Body stations, with dimension from reference datum to structural Station 0, if different from the reference datum, and identifying principal structural stations.
- c. Leveling lugs, or device: Identify type and specific location.
- d. Main bulkheads, crew stations, the prominent items of equipment suitably labeled to provide easy identification. Equipment need be shown only in sufficient detail to enable field personnel to determine relative locations. For transport type aircraft, additional plan view diagrams shall be included to show alternate passenger or troop seat, or litter arrangement.
- e. A scale in inches to facilitate the determination of approximate horizontal moment arms from the reference datum.
- f. The length of the MAC and the distance from its leading edge to the reference datum. Incidence of the MAC shall not be shown. For rotorcraft the distance from the reference datum to the centerline of the main rotor shall be given.
- g. Location, and distance in inches from reference datum, of suitable jugged points or fittings from which measurements may be taken to locate the reactions during weighings. Identify as "Dimension I." Jack pads may be used when they are jugged. These points shall be described to facilitate ready and accurate location in the field, or shown diagrammatically by an enlarged detail.
- h. Landing or beaching gear dimension data: Show dimension lines and identify as follows:
 - (1) Jig point to centerline of main wheels, "Weighing Dimension B."
 - (2) Distance between centerlines of main and nose or tail wheels, "Weighing Dimension D."
 - (3) Reference datum to centerline of nose or tail wheel, "Dimension F."
 - (4) Reference datum to centerline main wheels, "Dimension E."

MIL-W-25140B

AIRCRAFT DIAGRAM



NOTE: REFER TO WEIGHING INSTRUCTIONS ON PAGE 1 FOR DETAILS AND DIMENSIONS OF HOISTING LUGS, JIG POINT, JACK POINTS, AND LANDING GEAR WHEELS.

FIGURE 7. Sample aircraft diagram for class 2 aircraft.

MIL-W-25140B

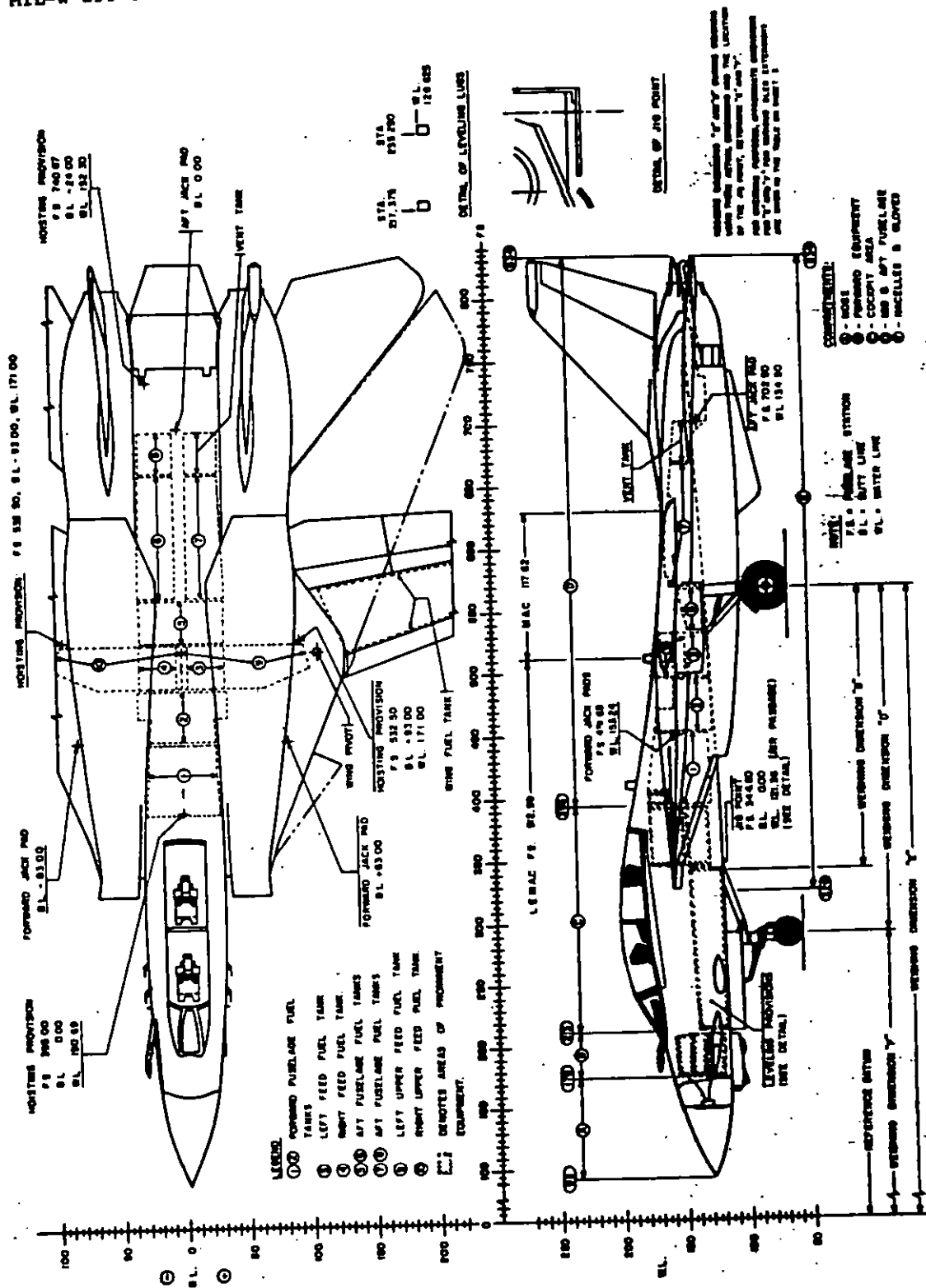
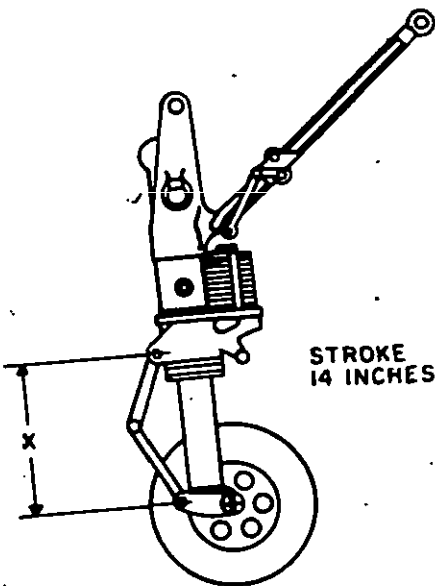


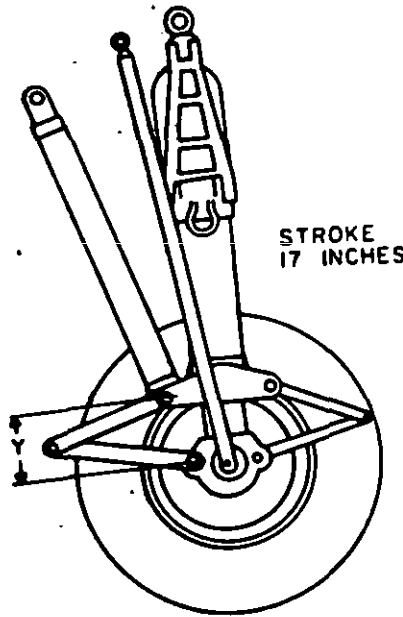
FIGURE 8. Sample aircraft diagram for class 1A and 1B aircraft.

MIL-W-25140B

| LANDING GEAR DIMENSIONS | | | | | |
|-------------------------|----------|-------|------------------|----------|--------|
| NOSE WHEEL | | | MAIN WHEELS | | |
| X | * DIM. F | | Y | * DIM. E | |
| Fully Compressed | 5.32 | 69.08 | Fully Compressed | 4.81 | 229.79 |
| | 6.32 | 69.15 | | 5.81 | 229.86 |
| | 7.32 | 69.23 | | 6.81 | 229.93 |
| | 8.32 | 69.31 | Static Condition | 7.81 | 230.00 |
| | 9.32 | 69.38 | | 8.81 | 230.07 |
| | 10.32 | 69.47 | | 9.81 | 230.14 |
| | 11.32 | 69.55 | | 10.81 | 230.21 |
| | 12.32 | 69.62 | | 11.81 | 230.28 |
| | 13.32 | 69.70 | | 12.81 | 230.35 |
| | 14.32 | 69.78 | | 13.81 | 230.42 |
| Static-Fully Extended | 15.32 | 69.86 | | 14.81 | 230.48 |
| | 16.32 | 69.94 | | 15.81 | 230.55 |
| | 17.32 | 70.02 | | 16.81 | 230.62 |
| | | | | 17.81 | 230.69 |
| | | | | 18.81 | 230.76 |
| | | | | 19.81 | 230.83 |
| | | | | 20.81 | 230.90 |
| | | | Fully Extended | 21.81 | 230.97 |
| | | | | | |
| | | | | | |



STROKE
14 INCHES



STROKE
17 INCHES

* APPROXIMATE. DETERMINE ACTUAL DIMENSIONS
DURING WEIGHING.

RH GEAR LOOKING OUTB'D

FIGURE 9. Sample landing gear dimension data.

MIL-W-25140B

(5) Add an asterisk to all four dimensions and the following asterisk note in a conspicuous place on the page: *"*Measure dimensions 'B' and 'D' during weighing. Using these actual dimensions and the jig point dimension 'I', determine 'E' and 'F'. For checking purposes, approximate dimensions 'E' and 'F' for various oleo extensions are given in the table on page ____."*

(6) Include a table on the referenced page listing dimensions 'E' and 'F' corresponding to various shock strut extensions from fully compressed to fully extended positions. Label the table: *"Approximate. Determine actual dimensions during weighing."*

(7) Include a detail of the shock strut to identify specifically where the shock strut extensions are to be measured. The contractor shall verify the accuracy of these dimensions during the weighings required by the contractual weighing schedule and advise the procuring activity of the shock strut extension and landing gear dimensions obtained.

i. Show all additional points, such as landing gear and wing jack points, lift tubes, tail hoist fittings, etc., which might be used as reaction points during weighings together with distances to the reference datum. Identify as "Dimension E" or "Dimension F," as appropriate. For these dimensions (except for jack points on landing gears), add a note: *"Actual measurements during weighing are not necessary. After leveling the aircraft, these dimensions for 'E' and 'F' may be inserted directly in the weighing form."*

j. For class 1A and 1B aircraft only, stations or compartments where miscellaneous equipment for ferry flights can be carried, including the maximum allowable weight and the moment for each 10 pounds of weight for each station or compartment.

k. For class 2 aircraft only, compartment centroids, locations, and distances from the reference datum. These shall be the values used for the compartment loading data.

NOTE: If small detail sketches and descriptive information can be used to advantage in presenting the information required for weighing purposes in 3.7.9.5.2c, g, h, and i above, or in reducing complexity in the aircraft diagram, these data may be included on the "Weighing instruction" page. Add suitable cross references of the aircraft diagram such as "See Weighing instructions on page _____, for jig point detail."

MIL-W-25140B

3.7.9.5.3 Fuel and oil loading data. Moments shall be given for fuel and oil quantities in pounds in appropriate increments from zero usable fuel and oil to maximum quantity indicated on the gage dials. The "normal full" fuel capacity (based on 6.0 lb/gal for Specification MIL-F-5572 fuel and 6.5 lb/gal for Specification MIL-F-5624 fuel) shall be identified in the table and the following notes added to the table:

"Full tanks with Specification MIL-F-5572 gasoline at 6.0 lb/gal."

or

"Full tanks with Specification MIL-F-5624, JP-2 (JP-4) at 6.5 lb/gal."

or

"Full tanks with Specification MIL-F-5624, JP-5 at 6.8 lb/gal."

"Total weight of fuel is dependent upon the specific gravity and temperature. Therefore, the notation 'full' does not appear on the fuel quantity gages. Variation should be anticipated in gage readings when tanks are full."

When an aircraft can be operated with more than one type of fuel with varying specific gravity, tables shall be included for all types; if the effect on the moment data, because of varying fuel specific gravity, does not materially affect the aircraft c.g., the data may be combined into a single table using average data. The capacity of each tank as determined by actual calibration shall be stated. If it is necessary to use a calculated capacity for the initial issue of Chart E, the capacity listed shall be appropriately labeled, and actual data inserted in the earliest possible revised issue of Chart E. Dry weight, capacity, type, and moment data shall be given for all external droppable tanks, including any attachments not listed on Chart A. The fuel and oil c.g. used in computing the moments shall be tabulated. The effect on variation in fuel c.g. for varying amounts of fuel shall be considered in preparing the moment data. In such cases, the arms may be listed for 1/4, 1/2, 3/4 and full for each tank. When tanks are interconnected to fill and drain as a single tank, they shall be totalized and treated as a single tank. When an automatic feed and transfer system is used, data shall be presented in a manner which will make clear the sequence in which fuel is loaded into and consumed from the system to permit a loading check to be made.

3.7.9.5.4 Water injection fluid data. Weights, arms, and moments shall be listed in appropriate increments (gallons and pounds) of fluid. The weight per gallon of fluid shall be listed.

MIL-W-25140B

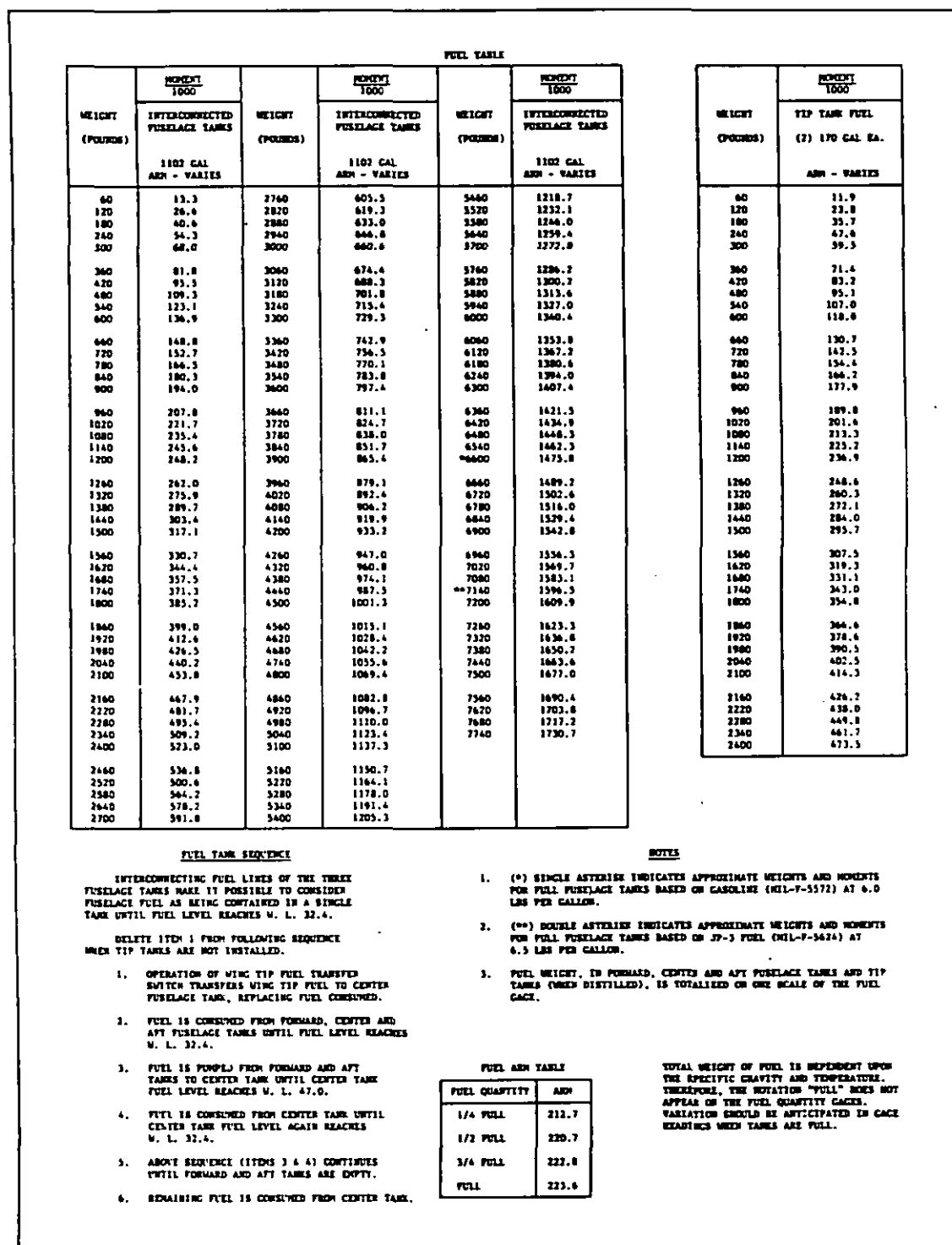


FIGURE 10. Sample fuel loading data.

3.7.9.5.5 Stores loading data. Moments shall be given for various weights of stores (bombs, clusters, special stores, torpedoes, depth bombs, etc.) for each bomb bay or station, together with the arms on which the moments are based. Maximum loadings shall be stated for each station. For cases where slight variations of arms occur because of various type and size store carried on a given rack or at a given station, an average arm chosen to yield the minimum moment error shall be used. Consideration shall be given to a separate tabulation for a given type or size store if the aircraft c.g. would be materially affected by including this type or size store at the average arm. Weights, arms, and moments, together with appropriate explanations, shall be included when special racks, pylons, or adapters are required which are not included on the Chart A.

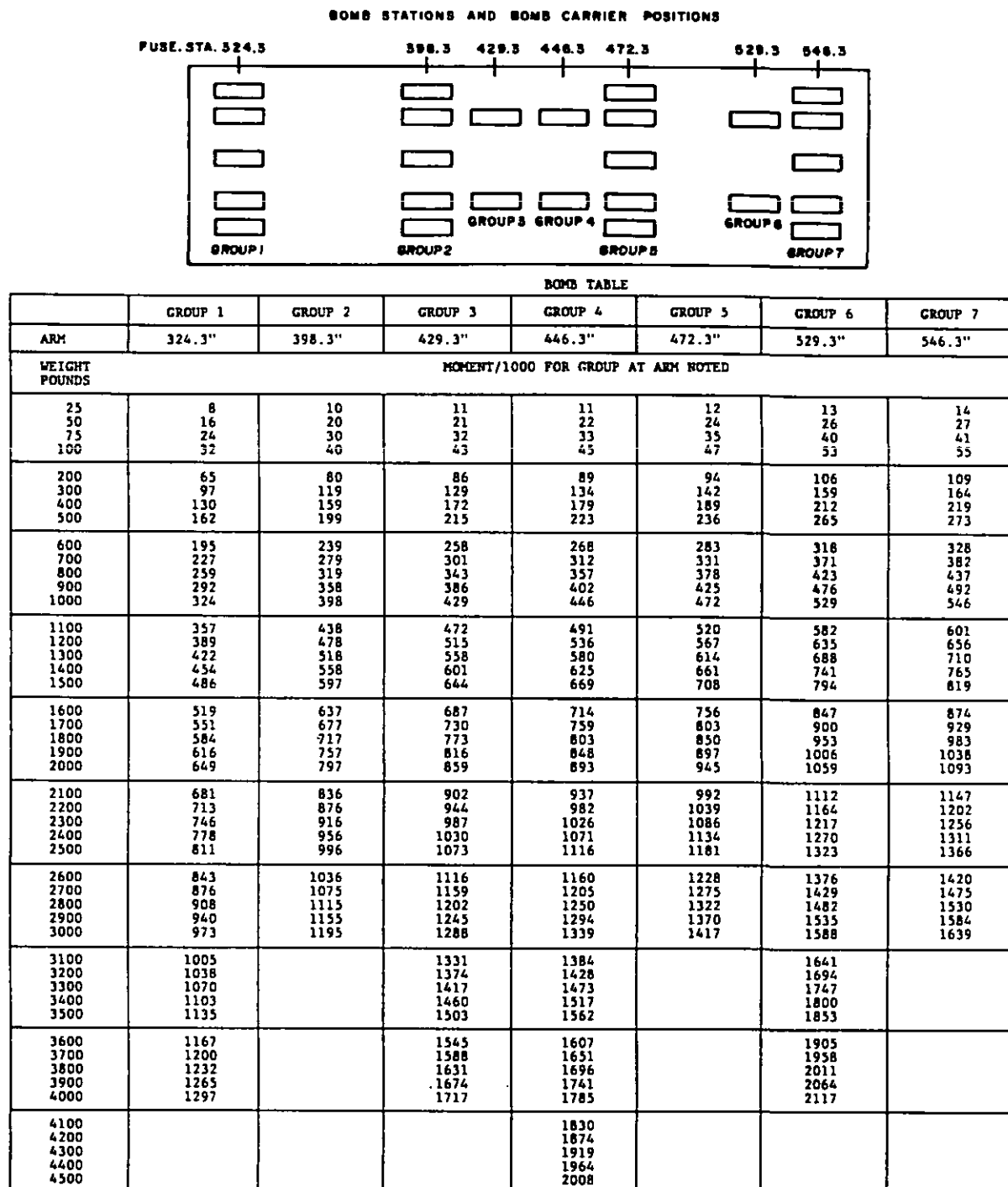
3.7.9.5.6 Ammunition loading data. Ammunition weights, arms, and moments shall be given for each gun station, including the compartment designation, ammunition capacity, and caliber. For guns fed from a remote source, ammunition in feed chutes shall be listed separately, and capacity indicated. When ammunition cases and links are retained in the aircraft, a note to this effect (with weight, arm, and moment data for the retained items) shall be included. When ballast is provided, or required, for installation when the aircraft is flown without retained cases and links, weight, arm, and moment data, and identification of ballast by part number if contractor-furnished, shall be tabulated with appropriate notes concerning its use.

3.7.9.5.7 Rocket projectile loading data. Rocket weights, arms, and moments, including location, maximum quantity, and type shall be given.

3.7.9.5.8 Camera loading data for photographic aircraft. Weights, arms, and moments shall be given for cameras, magazines and film, flashbombs, and typical camera and magazine combinations. When special mounts or ballast, variable with the camera installation, are utilized, weights, arms, and moments shall be included for these items with appropriate explanations.

3.7.9.5.9 Assisted takeoff (ATO) data. Weights, arms, and moments shall be given for the ATO bottles in the "installed" location, including the compartment designation, number of units, and size. Data shall also be shown for the empty units with charge expended. If provision is made for stowing extra units, data shall also be listed for the units in "stowed" location and the data labeled "installed" and "stowed."

MIL-W-25140B



Aero 12A shackle, 16 lb each, used with 2,000-lb class stores.
 Mk 7 Mod 1 shackle, 8 lb each, used with smaller class stores.

CAUTION: See arming and dropping sequencing instructions in Flight Handbook. To avoid extreme aircraft cg shift, stores must be loaded and dropped alternately from groups 1 and 7, and from groups 2 and 5.

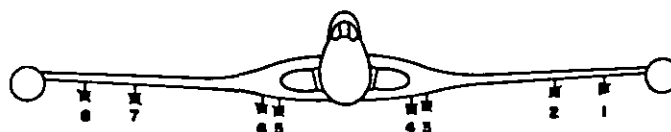
FIGURE 11. Sample stores loading data for class 2 aircraft.

MIL-W-25140B

AMMUNITION LOADING TABLE

ARMAMENT 4 - 20 M M GUNS

| ROUNDS PER GUN | WEIGHT PER GUN | MOMENT/1000 | | TOTAL AMMUNITION 4 GUNS ARM 67.3 | | | TOTAL ESTIMATED CASES & LINKS ARM 64.0 | |
|----------------------|----------------------|-------------------------------------|--------------------------------------|--|--------|----------------|--|----------------|
| | | INBOARD LH OR RH GUN ARM 62.0 | OUTBOARD LH OR RH GUN ARM 72.5 | ROUNDS | WEIGHT | MOMENT 1000 | WEIGHT | MOMENT 1000 |
| 10 | 6.2 | .4 | .4 | 40 | 24.8 | 1.6 | 10.8 | .7 |
| 20 | 12.4 | .8 | .9 | 80 | 49.6 | 3.4 | 21.6 | 1.4 |
| 30 | 18.6 | 1.2 | 1.3 | 120 | 74.4 | 5.0 | 32.4 | 2.1 |
| 40 | 24.8 | 1.5 | 1.8 | 160 | 99.2 | 6.6 | 43.2 | 2.8 |
| 50 | 31.0 | 1.9 | 2.2 | 200 | 124.0 | 8.2 | 54.0 | 3.5 |
| 60 | 37.2 | 2.3 | 2.7 | 240 | 148.8 | 10.0 | 64.8 | 4.1 |
| 70 | 43.4 | 2.7 | 3.1 | 280 | 173.6 | 11.6 | 75.6 | 4.8 |
| 80 | 49.6 | 3.1 | 3.6 | 320 | 198.4 | 13.4 | 86.4 | 5.5 |
| 90 | 55.8 | 3.5 | 4.0 | 360 | 223.2 | 15.0 | 97.2 | 6.2 |
| 100 | 62.0 | 3.8 | 4.5 | 400 | 248.0 | 16.6 | 108.0 | 6.9 |
| 110 | 68.2 | 4.2 | 4.9 | 440 | 272.8 | 18.2 | 118.8 | 7.6 |
| 120 | 74.4 | 4.6 | 5.4 | 480 | 297.6 | 20.0 | 129.6 | 8.3 |
| 130 | 80.6 | 5.0 | 5.8 | 520 | 322.4 | 21.6 | 140.4 | 9.0 |
| 140 | 86.8 | 5.4 | 6.3 | 560 | 347.2 | 23.4 | 151.2 | 9.7 |
| 150 | 93.0 | 5.8 | 6.7 | 600 | 372.0 | 25.0 | 162.0 | 10.4 |



BOMB AND ROCKET TABLE

| ITEM | BOMB OR ROCKET STATIONS | WEIGHT OF PAIR | ARM | MOMENT 1000 |
|-------------------------|-------------------------------|----------------------|-------|----------------|
| H.V.A.R. 5 INCH ROCKETS | 1 & 8 | 280 | 216.0 | 60 |
| | 2 & 7 | 280 | 228.1 | 64 |
| | 3 & 6 | 280 | 202.6 | 57 |
| | 4 & 5 | 280 | 202.6 | 57 |
| 100 LB G.P. BOMBS | 1 & 8 | 235 | 214.6 | 51 |
| | 2 & 7 | 235 | 226.7 | 53 |
| | 3 & 6 | 235 | 201.2 | 47 |
| | 4 & 5 | 235 | 201.2 | 47 |
| 250 LB G.P. BOMBS | 3 & 6 | 534 | 201.0 | 107 |
| | 4 & 5 | 534 | 201.0 | 107 |
| 500 LB G.P. BOMBS | 4 & 5 | 1106 | 201.0 | 222 |

NOTES

1. AUTOMATIC FIRING SEQUENCE BY STATIONS IS AS FOLLOWS:
SINGLE - 1, 7, 3, 5, 8, 2, 6, 4
PAIRS - 1 & 8, 2 & 7, 3 & 6, 4 & 5
2. ABOVE SEQUENCE OF FIRING BOMBS & ROCKETS SHOULD BE FOLLOWED AS ARBITRARY MANUAL SELECTION MAY RESULT IN CENTER OF GRAVITY BALANCE CONDITIONS WHICH EXCEED THE RECOMMENDED LIMITS
3. BOMBS & ROCKETS MAY BE CARRIED AS FOLLOWS:
500 LB BOMBS - STATIONS 4 & 5
250 LB BOMBS - STATIONS 3, 4, 5, 6
100 LB BOMBS - ALL STATIONS
ROCKETS - ALL STATIONS
4. BRITISH BOMBS FOR ROCKETS ARE CARRIED AT STATIONS 3 & 6 WHEN 500 LB BOMBS ARE INSTALLED

FIGURE 12. Sample ammunition, rocket projectile, and stores loading data for class 1A and 1B aircraft.

MIL-W-25140B

| TABLE OF INDIVIDUAL CAMERA & EQUIPMENT WEIGHTS | | | | | | | | |
|---|--|--------|----------------|---|------------------|------------------|-------------------|------------------|
| ITEM | WEIGHT | ARM | MOMENT 1000 | ITEM | WEIGHT | ARM | | |
| FORWARD BAY Cameras: S-7-S K-17-6 K-17-12 CA-8 Magazines: A-5A A-9 MA-6 Amplifier | 69 | 38 | 2.6 | AFT BAY Cameras: K-18-24 K-17-24 K-17-6(3) Magazines: A-7 A-8 A-5A(3) A-9 Ballast (PN 139949)* Ballast (PN 142432)** | 66 | 58 | | |
| | 37 | 39 | 1.4 | | 59 | 58 | | |
| | 43 | 39 | 1.7 | | 111 | 58 | | |
| | 40 | 39 | 1.6 | | | | | |
| | 29 | 39 | 1.1 | | 27 | 58 | | |
| | 37 | 39 | 1.4 | | 44 | 58 | | |
| | 32 | 39 | 1.2 | | 87 | 58 | | |
| | 24 | 42 | 1.0 | | 37 | 58 | | |
| | | | | | 118 | 12 | | |
| | | | | | 175 | 38 | | |
| | AFT BAY - ARM = 58" (APPROX.) | | | | | | | |
| | TOTAL WEIGHTS AND MOMENTS OF TYPICAL CAMERA & MAGAZINE COMBINATIONS | | | | | | | |
| | CAMERA & MAGAZINE COMBINATIONS | | | | | | | |
| | FWD. BAY - ARM = 39" (APPROX.) | WEIGHT | MOM. 1000 | | K-18-24 & A-7 | K-18-24 & A-8 | K-17-24 & A-5A | K-17-24 & A-9 |
| | | | | | | | | |
| CAMERA & MAGAZINE COMBINATIONS | 186 | 9.0 | 203 | 10.0 | 181 | 8.7 | 189 | 9.1 |
| | 159 | 7.9 | 176 | 8.9 | 154 | 7.6 | 162 | 8.0 |
| | 167 | 8.2 | 184 | 9.2 | 162 | 7.9 | 170 | 8.3 |
| | 165 | 8.2 | 182 | 9.2 | 160 | 7.9 | 168 | 8.3 |
| | 173 | 8.5 | 190 | 9.5 | 168 | 8.2 | 176 | 8.6 |
| S-7-S & Amplifier | 165 | 8.2 | 182 | 9.2 | 160 | 7.9 | 168 | 8.3 |
| K-17-6 & A-5A | | | | | | | 291* | 15.0 |
| K-17-6 & A-9 | | | | | | | 264* | 13.9 |
| K-17-12 & A-5A | | | | | | | 272* | 14.2 |
| K-17-12 & A-9 | | | | | | | 270* | 14.2 |
| CA-8 & MA-6 | | | | | | | 278* | 14.5 |
| | | | | | | | 270* | 14.2 |
| *Ballast (PN 139949) required in ALL camera combinations, except those marked with an asterisk (*). | | | | | | | | |
| **Ballast (PN 142432) required in lieu of cameras when NO cameras are aboard. | | | | | | | | |

FIGURE 13. Sample camera data for photographic aircraft.

MIL-W-25140R

3.7.9.5.10 Compartment loading data for class 2 aircraft

3.7.9.5.10.1 Cargo transport types. For all cargo compartments, moments shall be listed for cargo weight from zero to maximum capacity in appropriate increments based on the area centroid of the compartment. The capacity shall be considered to be the structural capacity (as limited by basic structural considerations), or the maximum allowable floor load, whichever is the lower. A supplementary table shall be furnished, listing for each compartment the compartment designation, centroid, arm limits, capacity, floor area, volume, maximum uniformly distributed load over the entire area (and over a limited area if variable), maximum concentrated load over a stated maximum area (such as floor beams, etc.). If the capacity is limited by floor strength and if the loading carrying capability of the aircraft might accommodate additional cargo weight, include a statement that the compartment capacities may be increased _____ pounds by installation of supplementary or overlay flooring. In sectionalizing the cargo area of large cargo-type aircraft into compartments, the compartment lengths shall not exceed values obtained from the following parameters:

$$L = \frac{0.15 \text{ cW}}{G} \text{ for aircraft}$$

$$L = \frac{RW}{G} \text{ for rotorcraft}$$

Where L = maximum length in inches for equal length compartments

c = MAC length in inches for aircraft

R = Length of permissible c.g. range in inches for rotorcraft

G = Maximum takeoff gross weight minus (minimum operating basic weight plus weight of the specified crew), or 75 percent of the maximum possible cargo load based on fuselage structural limitations, whichever is the lower.

W = Minimum operating basic weight plus weight of specified crew plus G.

Individual compartment lengths may be increased or decreased to allow the compartment limits to fall at fuselage frames, discontinuities in floor plan or allowable floor loading, etc., or to avoid falling in between cargo or entrance door limits, etc., provided that after such adjustments:

MIL-W-25140B

COMPARTMENT DATA

| COMPARTMENT | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|
| FORWARD LIMIT | 80 | 150 | 280 | 351 | 432 | 545 | 629 | 718 | 807 | 879 | 944 | 1007 | 1093 | 1172 |
| AFT LIMIT | 150 | 260 | 351 | 432 | 545 | 629 | 718 | 807 | 879 | 944 | 1007 | 1093 | 1172 | 1258 |
| FLOOR AREA - SQUARE FEET | | | 64 | 63 | 89 | 71 | 6 | 74 | 59 | 53 | 49 | 60 | 47 | 29 |
| MAX. CAPACITY POUNDS PER SQUARE FOOT | | | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| MAX. CAPACITY - POUNDS | | 800 | 2900 | 2800 | 4000 | 3200 | 3400 | 3300 | 2700 | 2400 | 2200 | 2700 | 2100 | 1300 |
| MAX. CAPACITY WITH CHART A ITEMS INSTALLED - POUNDS | | 149 | 2582 | 2409 | 2826 | 2195 | 1427 | 1622 | 2005 | 1328 | 1248 | 2404 | 1839 | 716 |

* Crew weight must be included in these capacities. Capacities for compartments E, K, and M do not include the weights of ammunition, sonobuoys and flares for which separate tables and capacities are listed on sheets 5 and 6 of Chart E.

** Includes the increase in maximum capacity possible by removal of equivalent weight of equipment listed on Chart A.

COMPARTMENT TABLE

| COMPARTMENT | B | C | D | E | F | G | H | I | J | K | L | M | N |
|----------------------|---|-----|------|------|------|------|------|------|------|------|------|------|------|
| COMPARTMENT CENTROID | 207 | 306 | 392 | 489 | 587 | 674 | 763 | 843 | 912 | 976 | 1050 | 1133 | 1215 |
| WEIGHT | MOMENT/1000 FOR COMPARTMENTS AT CG LISTED ABOVE | | | | | | | | | | | | |
| 10 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | 11 | 11 | 12 |
| 20 | 4 | 6 | 8 | 10 | 12 | 13 | 15 | 17 | 18 | 20 | 21 | 23 | 24 |
| 30 | 6 | 9 | 12 | 15 | 18 | 20 | 23 | 25 | 27 | 29 | 32 | 34 | 36 |
| 40 | 8 | 12 | 16 | 20 | 23 | 27 | 31 | 34 | 36 | 39 | 42 | 45 | 49 |
| 50 | 10 | 15 | 20 | 24 | 29 | 34 | 38 | 42 | 46 | 49 | 53 | 57 | 61 |
| 60 | 12 | 18 | 24 | 29 | 35 | 40 | 46 | 51 | 55 | 59 | 63 | 68 | 73 |
| 70 | 14 | 21 | 27 | 34 | 41 | 47 | 53 | 59 | 64 | 68 | 74 | 79 | 85 |
| 80 | 17 | 24 | 31 | 39 | 47 | 54 | 61 | 67 | 73 | 78 | 84 | 91 | 97 |
| 90 | 19 | 28 | 35 | 44 | 53 | 61 | 69 | 76 | 82 | 88 | 95 | 102 | 109 |
| 100 | 21 | 31 | 39 | 49 | 59 | 67 | 76 | 84 | 91 | 98 | 105 | 113 | 122 |
| 200 | 41 | 61 | 78 | 98 | 117 | 135 | 153 | 169 | 182 | 195 | 210 | 227 | 243 |
| 300 | 62 | 92 | 118 | 147 | 176 | 202 | 229 | 253 | 274 | 293 | 315 | 340 | 365 |
| 400 | 83 | 122 | 157 | 196 | 235 | 270 | 305 | 337 | 365 | 390 | 420 | 453 | 486 |
| 500 | 104 | 153 | 196 | 245 | 294 | 337 | 382 | 422 | 456 | 488 | 525 | 567 | 608 |
| 600 | 124 | 184 | 235 | 293 | 352 | 404 | 458 | 506 | 547 | 586 | 630 | 680 | 729 |
| 700 | 145 | 214 | 274 | 342 | 411 | 472 | 534 | 590 | 638 | 683 | 735 | 793 | 851 |
| 800 | 166 | 245 | 314 | 391 | 470 | 539 | 610 | 674 | 730 | 781 | 840 | 906 | 972 |
| 900 | | 275 | 353 | 440 | 528 | 607 | 687 | 759 | 821 | 878 | 945 | 1020 | 1094 |
| 1000 | | 306 | 392 | 489 | 587 | 674 | 763 | 843 | 912 | 976 | 1050 | 1133 | 1215 |
| 1200 | | 367 | 470 | 587 | 704 | 809 | 916 | 1012 | 1094 | 1171 | 1260 | 1360 | 1458 |
| 1400 | | 428 | 549 | 685 | 822 | 944 | 1068 | 1180 | 1277 | 1366 | 1470 | 1586 | 1701 |
| 1600 | | 490 | 627 | 782 | 939 | 1078 | 1221 | 1349 | 1459 | 1562 | 1680 | 1813 | 1959 |
| 1800 | | 551 | 706 | 880 | 1057 | 1213 | 1373 | 1517 | 1647 | 1757 | 1890 | 2039 | 2206 |
| 2000 | | 612 | 784 | 978 | 1174 | 1348 | 1526 | 1686 | 1824 | 1952 | 2100 | 2266 | 2443 |
| 2200 | | 673 | 862 | 1076 | 1291 | 1483 | 1679 | 1855 | 2006 | 2147 | 2310 | 2493 | |
| 2400 | | 734 | 941 | 1174 | 1409 | 1618 | 1831 | 2023 | 2189 | | 2520 | | |
| 2600 | | 796 | 1019 | 1271 | 1526 | 1752 | 1984 | 2192 | | | 2730 | | |
| 2800 | | 857 | 1098 | 1369 | 1644 | 1837 | 2136 | 2360 | | | 2940 | | |
| 3000 | | | 918 | 1467 | 1761 | 2022 | 2289 | | | | | | |
| 3200 | | | | 1565 | 1878 | 2157 | 2442 | | | | | | |
| 3400 | | | | 1663 | | 2282 | 2594 | | | | | | |
| 3600 | | | | 1760 | | | | | | | | | |
| 3800 | | | | 1858 | | | | | | | | | |
| 4000 | | | | 1956 | | | | | | | | | |

FIGURE 14. Sample compartment loading data for class 2 aircraft
(for other than cargo transport types).

$$g_1 L_1 + g_2 L_2 + \dots + g_n L_n = GL \quad (2)$$

where L_1, L_2, \dots, L_n = individual compartment lengths

g_1, g_2, \dots, g_n = individual compartment capacities
when G is based on maximum takeoff
gross weight, or 75 percent of
individual compartment capacities
when G is based on fuselage
structural limitations.

For aircraft in which several cargo areas are provided, the cargo values for g and G in the above parameters shall be considered as the cargo in all such areas. For other than the cargo compartments, the requirements of 3.7.9.5.10.2 shall apply.

3.7.9.5.10.2 All other types. Moments shall be listed for miscellaneous loads, for which separate capacities are not listed elsewhere in Chart E, from zero to maximum capacity in appropriate increments. Miscellaneous loads will normally consist of crew, baggage, cargo, and items of an unspecified nature that might be stowed on ferry or special missions utilizing available floor area and stowage locker capacities. The compartment centroids shall be based on the weighed average arms of the miscellaneous loads. The capacity shall be considered to be the structural capacity (as limited by basic structural considerations), or a capacity based on summation of the known items of load plus allowable floor and stowage locker loads, whichever is the lower. A supplementary table shall be furnished, listing for each compartment the compartment designation, centroid, arm limits, capacity, floor area and maximum floor loading, and stowage locker capacities. A statement shall be included that crew weight must be included in these capacities, that the capacity does not include the weight of ammunition and other Chart E items for which separate tables and capacities are provided, and that capacities can be increased _____ pounds, where applicable, by the removal of an equivalent weight of equipment listed on Chart A or by installation of supplementary flooring.

3.7.9.5.10.3 Basis for compartment capacities centroids. The basis for the compartment capacities, the centroids chosen, and data substantiating the compartment lengths for cargo transport aircraft shall be furnished to the procuring activity with the sample Chart E.

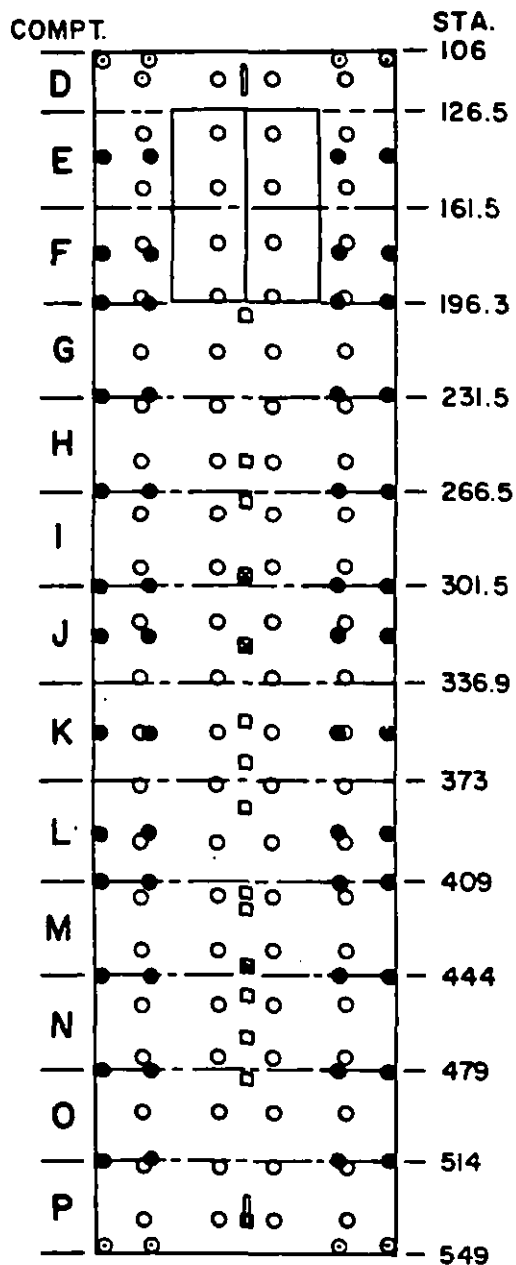
3.7.9.5.11 Cargo tiedown data for cargo types. A plan view of the cargo floor shall be provided showing the following:

a. Location and capacity of tiedown fittings. Compartment letter designations and station limits.

b. A note shall be added "Weight of cargo secured must not exceed fitting capacity. Refer to Cargo Loading Handbook for detailed information."

MIL-W-25140B

CARGO TIEDOWN DATA



LEGEND

- AN7516 FITTING
- 10,000 LB FITTING
- 5,000 LB FITTING
- ENGINE HOLD DOWN FITT'G
12,000 LB
- ENGINE HOLD DOWN FITT'G
7,000 LB

-ULTIMATE CAPACITIES-

NOTES:

- (1) Weight of cargo secured must not exceed fitting capacities. Refer to Cargo Loading Handbook for detailed information.
- (2) Compartment capacities must not be exceeded. See compartment capacities on sheet 4.

FIGURE 15. Sample cargo tiedown data for class 2 cargo types.

MIL-W-25140B

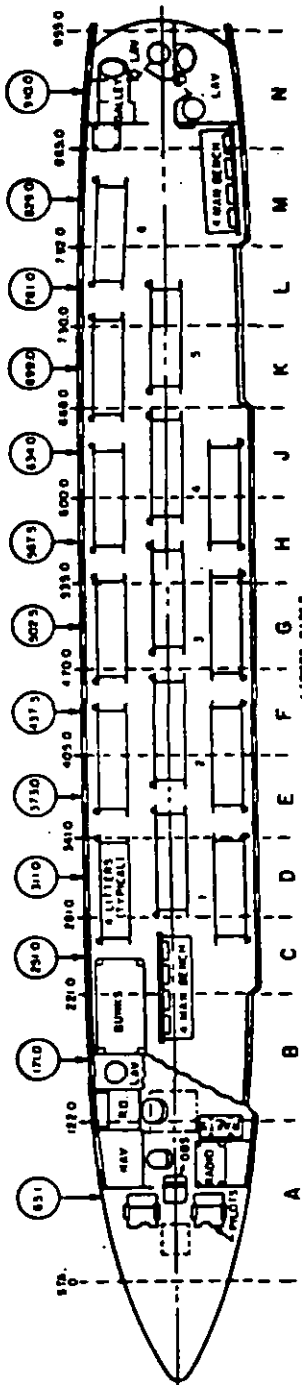
3.7.9.5.12 Passenger, troop, and litter data. Weights, arms, and moments shall be given for passengers, troops, litters, and patients, with each position, seat, row, etc., identified in the same manner as shown on the aircraft diagram.

3.7.9.5.13 Personnel movement data. For class 1A and 1B aircraft, moment arms and moments shall be given for each crew station, and moment changes accompanying shift of personnel to any station to which movement in flight is possible. For class 2 aircraft, similar data, based on compartment centroids, shall be given for compartment occupied or to which movement in flight is possible. Personnel weights shall be based on the weights specified by the procuring activity in the applicable design specifications. When fixed stowage is provided for parachutes, the personnel weights shall be decreased by the parachute weight as specified in the applicable design specifications, and a note added "Based on _____ pounds per man. Parachutes listed in Chart A." When no stowage is provided for parachutes, a note shall be added "Based on _____ pounds per man, including parachute." When personnel weights vary (e.g., different weights for crew and passengers), the heaviest weight shall be used.

3.7.9.5.14 Miscellaneous equipment data. Compartment designations, quantities, weights, arms, and moments shall be given for miscellaneous items of equipment not shown elsewhere in Chart E. Included in this category are heavy items of equipment, such as engines and cradles, tanks, jeeps, and field pieces for which specific stowage provisions are made; and flares, sonobuoys, etc., the weight and location of which materially affect aircraft c.g.

3.7.9.5.15 Center of gravity data. (Wherever "percent MAC" is referred to in this requirement, it shall be understood to apply to aircraft, and "inches aft of the reference datum" shall be understood to apply in the case of rotorcraft.) For various gross weights from basic to maximum, in equal weight increments based on the parameter given below, moments shall be tabulated in columns for the recommended forward and aft center of gravity limits and for several whole number percent MAC values spaced as evenly as possible between these limits. When special restrictions resulting from aerodynamic, structural, assisted takeoff, or hydrodynamic conditions are applicable for certain c.g. regions within the limits, moments for these limiting c.g. locations shall also be tabulated. Where appropriate, such special restrictions alternatively may be covered in note form, provided that the choice of percent MAC values for which moments are tabulated are carefully chosen and so spaced that a loading check for compliance with the restrictions may be made directly. If it is necessary to utilize a region at the aft end of the permissible c.g. range, in which the stability is not positive under all conditions of flight, this region shall be identified by "Caution See Note," and the following note included:

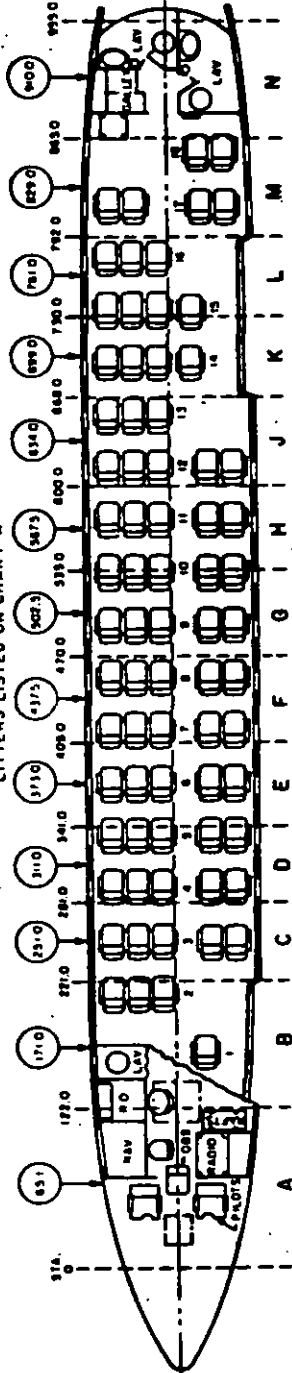
MIL-W-25140B



LITTER TABLE

| Location or Titer No. | 1 Pass | | 2 Pass | | 3 Pass | | 4 Pass | | 5 Pass | | 6 Pass | | 7 Pass | | 8 Pass | | 9 Pass | | 10 Pass | | 11 Pass | | 12 Pass | |
|-----------------------------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|---------|---------|---------|---------|---------|---------|
| | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. |
| Crew | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| Crew, Bench | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| Bench | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 1 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 2 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 3 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 4 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 5 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 6 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 7 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 8 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 9 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 10 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 11 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 12 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 13 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 14 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 15 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 16 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |
| 17 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 | 1870 | 1000 | 2040 | 1000 |

BASED ON 170 LBS./PATIENT
LITTERS LISTED ON CHART A



PASSENGER TABLE

| Location or Bene No. | 1 Pass | | 2 Pass | | 3 Pass | | 4 Pass | | 5 Pass | | 6 Pass | | 7 Pass | | 8 Pass | | 9 Pass | | 10 Pass | |
|----------------------------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|---------|---------|
| | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. | Compt. | /Compt. |
| Crew | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| Crew, Bench | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| Bench | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 1 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 2 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 3 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 4 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 5 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 6 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 7 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 8 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 9 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 10 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 11 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 12 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 13 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 14 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 15 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 16 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |
| 17 | 170 | 1000 | 340 | 1000 | 510 | 1000 | 680 | 1000 | 850 | 1000 | 1020 | 1000 | 1190 | 1000 | 1360 | 1000 | 1530 | 1000 | 1700 | 1000 |

PARACHUTES FOR CREW ARE
LISTED ON CHART A IN
STOWED POSITION.
OTHER PARACHUTES, WHEN
CARRIED, SHALL BE CONSIDERED
AS CARGO.

FIGURE 16. Sample of passenger and litter data.

TABLE OF MOMENTS FOR PERSONNEL MOVEMENT (MOMENT/1000)

| COMPARTMENT | B | C | D | E | F | G | H | I | J | K | L | M |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| ARM (INCHES) | 207 | 306 | 392 | 489 | 587 | 674 | 763 | 843 | 912 | 976 | 1050 | 1133 |
| ONE PASSENGER | 37 | 55 | 71 | 88 | 106 | 121 | 137 | 152 | 164 | 176 | 189 | 204 |
| N CABIN | 182 | 164 | 148 | 131 | 113 | 98 | 82 | 67 | 55 | 43 | 30 | 15 |
| M CABIN | 167 | 149 | 133 | 116 | 98 | 83 | 67 | 52 | 40 | 28 | 15 | |
| L CABIN | 152 | 134 | 118 | 101 | 83 | 68 | 52 | 37 | 25 | 13 | | |
| K CABIN | 139 | 121 | 105 | 88 | 70 | 55 | 39 | 24 | 12 | | | |
| J CABIN | 127 | 109 | 93 | 76 | 58 | 43 | 27 | 12 | | | | |
| I CABIN | 115 | 97 | 81 | 64 | 46 | 31 | 15 | | | | | |
| H CABIN | 100 | 82 | 66 | 49 | 31 | 16 | | | | | | |
| G CABIN | 84 | 66 | 50 | 33 | 15 | | | | | | | |
| F CABIN | 69 | 51 | 35 | 18 | | | | | | | | |
| E CABIN | 51 | 33 | 17 | | | | | | | | | |
| D CABIN | 34 | 16 | | | | | | | | | | |
| C CABIN | 18 | | | | | | | | | | | |

NOTE - ADD MOMENT FOR PASSENGER MOVEMENT AFT.
PLUS (+) SIGN. SUBTRACT FOR MOVEMENT
FORWARD, MINUS (-) SIGN.

Based on 180 lb per man.
Parachutes listed on
Chart A.

FIGURE 17. Sample personnel movement data for class 2 aircraft.

MIL-W-25140B

"NOTE: Flight in the 'Caution' region shall be avoided if practicable, but the aircraft can be flown safely in this region provided that the pilot is familiar with its flight characteristics. Increasing caution should be observed as the c.g. approaches the Aft Limit."

The above note may be expanded to include a very brief statement of the flight conditions in which instability is encountered, and reference made to the applicable Technical Orders or Flight Handbooks discussing stability characteristics for the model, when such have been issued by the procuring activity.

3.7.9.5.15.1 Each column of the c.g. table shall bear an appropriate heading. The limit moment columns shall be identified by appropriate nomenclature, of which the statements listed below are considered representative, and the percent MAC and arm from the reference datum shall be listed. For limits which for any reason are tapered between two gross weights, the taper shall be identified. The following statements are representative of those considered satisfactory for c.g. limit nomenclature:

Fwd Limit Wheels down.
Fwd Limit Wheels up.
Fwd Hydro. Limit.
Aft Limit Wheels up.
Aft Hydro. Limit.

3.7.9.5.15.2 The weight increment used for the c.g. table shall be 5, 10, 25, 50, 100, or a whole number multiple of 100 pounds. The nearest increment of those listed above to the increment calculated from the following formula shall be used, except that when the value obtained from the formula is greater than 200 the next higher whole number multiple of 100 pounds may be used:

$$\text{For aircraft } w = \frac{W_c}{100H}$$

$$\text{For rotorcraft } w = \frac{6RW}{100H}$$

Where w = Weight increment

W = Minimum basic weight plus weight of specified crew

c = MAC in inches, for aircraft

H = Arm for aft c.g. limit in inches

R = Length of permissible c.g. range in inches, for rotorcraft.

CENTER OF GRAVITY TABLE

(See sheet 7 for gross weights below 46,200 lb)
 (See sheet 9 for gross weights above 57,000 lb)

| GROSS WEIGHT (POUNDS) | CG LIMITS | | | | | | | | | |
|--------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| | MOMENT 1000 | | | | | | | | | |
| | 211 MAC (354.80) | 221 MAC (357.86) | 231 MAC (359.13) | 241 MAC (360.39) | 251 MAC (362.91) | 261 MAC (364.44) | 281 MAC (367.94) | 321 MAC (370.48) | 341 MAC (373.01) | 361 MAC (375.33) |
| 46,200 | 16475 | 16533 | 16592 | 16650 | 16766 | 16883 | 17000 | 17116 | 17233 | 17349 |
| 400 | 16546 | 16605 | 16664 | 16722 | 16839 | 16956 | 17073 | 17190 | 17308 | 17425 |
| 600 | 16618 | 16676 | 16735 | 16794 | 16912 | 17030 | 17147 | 17264 | 17382 | 17500 |
| 800 | 16689 | 16748 | 16807 | 16866 | 16984 | 17103 | 17221 | 17338 | 17457 | 17575 |
| 47,000 | 16760 | 16819 | 16879 | 16938 | 17057 | 17176 | 17294 | 17413 | 17531 | 17650 |
| 200 | 16832 | 16891 | 16951 | 17010 | 17129 | 17249 | 17368 | 17487 | 17606 | 17725 |
| 400 | 16903 | 16963 | 17023 | 17082 | 17202 | 17322 | 17441 | 17561 | 17681 | 17800 |
| 600 | 16974 | 17034 | 17095 | 17155 | 17275 | 17395 | 17515 | 17635 | 17755 | 17875 |
| 800 | 17045 | 17106 | 17166 | 17227 | 17347 | 17468 | 17588 | 17709 | 17830 | 17950 |
| 48,000 | 17117 | 17177 | 17238 | 17299 | 17420 | 17541 | 17662 | 17783 | 17904 | 18025 |
| 200 | 17188 | 17249 | 17310 | 17371 | 17492 | 17614 | 17736 | 17857 | 17979 | 18101 |
| 400 | 17259 | 17320 | 17382 | 17443 | 17565 | 17687 | 17809 | 17931 | 18054 | 18176 |
| 600 | 17331 | 17392 | 17454 | 17515 | 17637 | 17760 | 17883 | 18005 | 18128 | 18251 |
| 800 | 17402 | 17464 | 17526 | 17587 | 17710 | 17833 | 17956 | 18079 | 18203 | 18326 |
| 49,000 | 17473 | 17535 | 17597 | 17659 | 17783 | 17907 | 18030 | 18154 | 18277 | 18401 |
| 200 | 17545 | 17607 | 17669 | 17731 | 17855 | 17980 | 18104 | 18228 | 18352 | 18476 |
| 400 | 17616 | 17678 | 17741 | 17803 | 17928 | 18053 | 18177 | 18302 | 18427 | 18551 |
| 600 | 17687 | 17750 | 17813 | 17875 | 18000 | 18126 | 18251 | 18376 | 18501 | 18626 |
| 800 | 17759 | 17821 | 17885 | 17947 | 18073 | 18199 | 18324 | 18450 | 18576 | 18701 |
| 50,000 | 17830 | 17893 | 17957 | 18020 | 18146 | 18272 | 18398 | 18524 | 18651 | 18777 |
| 200 | 17901 | 17965 | 18028 | 18092 | 18218 | 18345 | 18472 | 18598 | 18725 | 18852 |
| 400 | | 18036 | 18100 | 18164 | 18291 | 18418 | 18545 | 18672 | 18800 | 18927 |
| 600 | | 18108 | 18172 | 18236 | 18363 | 18491 | 18619 | 18746 | 18874 | 19002 |
| 800 | | 18179 | 18244 | 18308 | 18436 | 18564 | 18692 | 18820 | 18949 | 19077 |
| 51,000 | | 18251 | 18316 | 18380 | 18508 | 18637 | 18766 | 18894 | 19024 | 19152 |
| 200 | | 18322 | 18387 | 18452 | 18581 | 18711 | 18840 | 18969 | 19098 | 19227 |
| 400 | | 18394 | 18459 | 18524 | 18654 | 18784 | 18913 | 19043 | 19173 | 19302 |
| 600 | | 18466 | 18531 | 18596 | 18726 | 18857 | 18987 | 19117 | 19247 | 19377 |
| 800 | | 18537 | 18603 | 18668 | 18799 | 18930 | 19060 | 19191 | 19322 | 19452 |
| 52,000 | | 18609 | 18675 | 18740 | 18871 | 19003 | 19134 | 19265 | 19397 | 19528 |
| 200 | | 18680 | 18747 | 18812 | 18944 | 19076 | 19208 | 19339 | 19471 | 19603 |
| 400 | | 18752 | 18818 | 18884 | 19016 | 19149 | 19281 | 19413 | 19546 | 19678 |
| 600 | | 18823 | 18890 | 18957 | 19089 | 19222 | 19355 | 19487 | 19620 | 19753 |
| 800 | | 18895 | 18962 | 19029 | 19162 | 19295 | 19428 | 19561 | 19695 | 19828 |
| 53,000 | | 18967 | 19034 | 19101 | 19234 | 19368 | 19502 | 19635 | 19770 | 19903 |
| 200 | | 19038 | 19106 | 19173 | 19307 | 19441 | 19575 | 19710 | 19844 | 19978 |
| 400 | | 19110 | 19178 | 19245 | 19379 | 19514 | 19649 | 19784 | 19919 | 20053 |
| 600 | | 19181 | 19249 | 19317 | 19452 | 19588 | 19723 | 19858 | 19993 | 20128 |
| 800 | | 19253 | 19321 | 19389 | 19525 | 19661 | 19796 | 19932 | 20067 | 20204 |
| 54,000 | | 19324 | 19393 | 19461 | 19597 | 19734 | 19870 | 20006 | 20143 | 20279 |
| 200 | | 19396 | 19465 | 19533 | 19670 | 19807 | 19945 | 20080 | 20217 | 20354 |
| 400 | | 19468 | 19537 | 19605 | 19742 | 19880 | 20017 | 20154 | 20298 | 20429 |
| 600 | | | 19608 | 19677 | 19815 | 19953 | 20091 | 20228 | 20364 | 20504 |
| 800 | | | 19680 | 19749 | 19887 | 20026 | 20164 | 20302 | 20441 | 20579 |
| 55,000 | | | 19752 | 19821 | 19960 | 20099 | 20238 | 20376 | 20516 | 20654 |
| 200 | | | 19824 | 19894 | 20033 | 20172 | 20311 | 20450 | 20590 | 20729 |
| 400 | | | 19896 | 19966 | 20105 | 20245 | 20385 | 20525 | 20665 | 20804 |
| 600 | | | 19968 | 20038 | 20178 | 20318 | 20459 | 20599 | 20739 | 20879 |
| 800 | | | 20039 | 20110 | 20250 | 20392 | 20532 | 20673 | 20814 | 20955 |
| 56,000 | | | 20111 | 20182 | 20323 | 20465 | 20606 | 20747 | 20889 | 21030 |
| 200 | | | 20183 | 20254 | 20396 | 20538 | 20679 | 20821 | 20963 | 21105 |
| 400 | | | 20255 | 20326 | 20468 | 20611 | 20753 | 20895 | 21038 | 21180 |
| 600 | | | 20327 | 20398 | 20541 | 20684 | 20827 | 20969 | 21112 | 21255 |
| 800 | | | 20399 | 20470 | 20613 | 20757 | 20900 | 21043 | 21187 | 21330 |
| 57,000 | | | 20470 | 20542 | 20686 | 20830 | 20974 | 21117 | 21262 | 21405 |

The forward CG limit wheels down is 201 MAC for all weights below 46,000 pounds and tapers to 291 MAC wheels down at 84,000 pounds. The aft CG limit wheels up is 361 MAC. Limits are based on contractors tests. Limits determined during Navy tests will be furnished when available.

Moment/1,000 for retraction of the landing gear is shown 107. Loadings based on wheels down condition which fall within the limiting moments in the table will be satisfactory for flight with landing gear retracted.

GROSS WEIGHT LIMITATIONS

Takeoff pounds*
 Landing pounds*
 Zero wing fuel gross weight pounds*

*Service activities shall insert, or substitute, current figures from the latest applicable Flight Handbook.

FIGURE 18. Sample center of gravity data.

MIL-W-25140B

3.7.9.5.15.3 Since the Weight Handbook is predicated on use of basic weight, wheels down, the loading checks are made on the basis of the gross weight, wheels down, and the moment values for one of the c.g. limits may require compensation for the moment owing to retraction of the alighting gear. The applicable procedure of the following shall be used:

a. If retraction of the alighting gear shifts the horizontal c.g. aft, the moments listed for the aft limit (or limits, if special restrictions or a "caution" region are involved) shall be reduced numerically by the moment owing to retraction of the alighting gear and the following note added:

"NOTE: Moment/constant for retraction of the alighting gear is (plus) (fill in value). Moment/constant values listed in this column are the moments corresponding to (fill in) percent MAC reduced by the moment for retraction of the alighting gear, and are equivalent to approximately (fill in) percent MAC at (fill in) pounds (contractor insert) figures for lowest weight of table) to (fill in) percent MAC at (fill in) pounds (contractor insert) figures for highest weight of table). Loadings based on the wheels-down condition which fall within the limiting moments listed in the table will be satisfactory when the alighting gear is retracted."

b. If retraction of the alighting gear shifts the c.g. forward, and the forward limit is based on the flight requirements for a configuration in which wheels are normally retracted, the moments listed for the forward limit shall be numerically increased by the moment for retraction of the alighting gear, and the following note added:

"NOTE: Moment/constant for retraction of the alighting gear is (minus) (fill in value). Moment/constant values listed in this column are the moments corresponding to (fill in) percent MAC increased by the moment for retraction of the alighting gear, and are equivalent to approximately (fill in) percent MAC at (fill in) pounds (contractor insert) figures for lowest weight of table) to (fill in) percent MAC at (fill in) pounds (contractor insert) figures for highest weight of table). Loadings based on the wheels-down condition which fall within the limiting moments in the table will be satisfactory when the alighting gear is retracted."

MIL-W-25140B

c. If retraction of the alighting gear shifts the c.g. forward, and the forward limit is based on the requirements for landing or takeoff, during which the alighting gear is extended, the moments listed for the forward limit need not be compensated, and the following note shall be added:

"NOTE: Moment/constant for retraction of the alighting gear is (minus) (fill in value). Loadings based on the wheels-down condition which fall within the limiting moments in the table, will be satisfactory for flight with alighting gear retracted."

In the event the c.g. shift for retraction of the alighting gear is so large that the flight requirements discussed in (b) above become operative, the procedure in (b) shall apply.

3.7.9.5.15.4 When c.g. limits are based on contractor's data, the following note, modified to suit the particular case, shall be included:

"NOTE: C.g. limits based on contractor's tests (or calculations, if applicable). Limits determined during Navy (Air Force) tests will be furnished when available."

3.7.9.5.15.5 The following tabulation and note marked with an asterisk shall be added below (or on the last page) of the c.g. table, with blank space provided for insertion of weight figures by Service activities:

Gross weight limitations

| | | | |
|-------------------------------|-------|--------|---|
| Takeoff | _____ | Pounds | * |
| Landing | _____ | Pounds | * |
| Catapulting (when applicable) | _____ | Pounds | * |
| Arresting (when applicable) | _____ | Pounds | * |

*NOTE: Service activities shall insert, or substitute, current figures from latest applicable (Technical Order) (Flight Handbook) covering operating restrictions.

For aircraft which have a gross weight restriction above which all weight must be fuel in the wings (e.g., a Zero Wing Fuel Gross Weight), list the "gross weight" properly identified.

MIL-W-25140B

3.7.9.5.15.6 For aircraft with alternate alighting gear, the c.g. limit table shall include limits for the alternate alighting gear conditions. These may be separate tables if necessary for clarity.

3.7.9.5.15.7 When Weight and Balance Status Reports are not required, the contractor shall furnish to the procuring activity with the sample Chart E references to the source of the recommended c.g. limits, brief indication of the critical flying qualities or structural considerations which dictated these limits, and reasons for any tapered or special c.g. restrictions.

3.7.9.5.16 Maximum package size data (for cargo transport aircraft only). Tabular data shall be given for determining the maximum allowable cargo package sizes, in all practicable combinations of dimensions, which can pass through the cargo loading doors. A sketch shall be included identifying the door openings concerned and showing their dimensions.

3.7.9.5.17 Miscellaneous data. A table of miscellaneous general information shall present data as follows: Seat (including crew and passenger) and litter centroids, general aircraft dimensions, including span, length, height (maximum), approximate wheel base and tread.

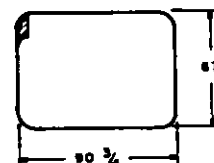
3.7.9.5.18 Typical loadings. For class 1A and class 1B aircraft only, a table of several typical service loads shall be included listing combinations of Chart E items with weights, arms, and moments for each item. Totals of the weights and moments for the items in each typical loading shall be shown.

3.7.9.6 Approval of Charts A and E. The following procedures shall apply in initial preparation and subsequent revision of these charts:

a. Sample Charts A and E shall be submitted to the procuring activity for initial approval approximately 1 month before the expected flight date of the first aircraft.

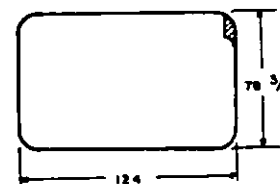
b. When it is necessary to insert copies of Charts A and E in handbooks prior to release by the procuring activity, each page of the Charts A and E shall be marked "Temporary."

c. As soon as possible after approval, forward three prints of the released Charts A and E to the procuring activity. Text shall be clearly legible with no characters blurred or filled in, and no smaller than the equivalent of 6 point type.

PACKING PACKAGE SIZE TABLE[illegible]**AFT CARGO ROOM**

| WEIGHT IN INCHES | | | | | | | | | | | | | | | | | | | |
|------------------|---------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Which Section | ad a Below | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 |
| | | NATION LENGTH - INCHES | | | | | | | | | | | | | | | | | |
| 3 | 623 | 623 | 623 | 623 | 623 | 623 | 623 | 623 | 620 | 617 | 598 | 578 | 567 | 523 | 499 | 473 | 466 | 428 | 417 |
| 6 | 623 | 623 | 623 | 623 | 623 | 623 | 623 | 623 | 620 | 605 | 593 | 581 | 567 | 521 | 501 | 476 | 449 | 431 | 393 |
| 9 | 623 | 623 | 623 | 623 | 623 | 623 | 623 | 623 | 618 | 595 | 578 | 556 | 533 | 496 | 477 | 453 | 436 | 417 | 386 |
| 12 | 603 | 603 | 580 | 573 | 563 | 543 | 530 | 511 | 506 | 496 | 472 | 458 | 432 | 417 | 404 | 387 | 372 | 363 | 336 |
| 15 | 536 | 536 | 511 | 506 | 499 | 489 | 475 | 460 | 445 | 436 | 428 | 403 | 391 | 380 | 369 | 358 | 349 | 341 | 330 |
| 18 | 486 | 477 | 463 | 453 | 444 | 435 | 424 | 414 | 404 | 394 | 384 | 367 | 351 | 347 | 341 | 330 | 321 | 312 | 302 |
| 21 | 436 | 421 | 414 | 404 | 395 | 383 | 374 | 363 | 354 | 346 | 336 | 326 | 312 | 311 | 308 | 299 | 291 | 284 | 277 |
| 24 | 390 | 390 | 383 | 376 | 368 | 363 | 356 | 348 | 339 | 330 | 326 | 322 | 319 | 308 | 299 | 291 | 284 | 279 | 271 |
| 27 | 345 | 350 | 340 | 347 | 341 | 336 | 329 | 323 | 315 | 307 | 298 | 289 | 281 | 278 | 273 | 269 | 266 | 263 | 259 |
| 30 | 336 | 330 | 323 | 316 | 311 | 304 | 300 | 294 | 286 | 279 | 273 | 271 | 264 | 260 | 257 | 254 | 251 | 247 | 245 |
| 33 | 311 | 311 | 301 | 301 | 298 | 292 | 287 | 282 | 278 | 271 | 263 | 255 | 248 | 244 | 239 | 235 | 231 | 227 | 224 |
| 36 | 290 | 290 | 284 | 282 | 280 | 276 | 272 | 267 | 263 | 256 | 249 | 243 | 235 | 231 | 228 | 224 | 219 | 216 | 213 |
| 39 | 274 | 271 | 269 | 267 | 264 | 260 | 256 | 251 | 248 | 247 | 247 | 239 | 234 | 234 | 231 | 228 | 224 | 221 | 218 |
| 42 | 259 | 259 | 254 | 252 | 250 | 247 | 243 | 238 | 235 | 230 | 223 | 219 | 216 | 216 | 209 | 199 | 194 | 191 | 189 |
| 45 | 247 | 244 | 242 | 240 | 238 | 235 | 231 | 226 | 221 | 216 | 213 | 208 | 206 | 201 | 197 | 193 | 189 | 185 | 181 |
| 48 | 234 | 232 | 230 | 229 | 226 | 222 | 218 | 214 | 211 | 208 | 204 | 199 | 196 | 192 | 188 | 185 | 182 | 177 | 175 |
| 51 | 227 | 228 | 218 | 216 | 214 | 210 | 207 | 203 | 200 | 195 | 191 | 188 | 184 | 180 | 177 | 174 | 172 | 170 | 168 |
| 54 | 210 | 208 | 206 | 205 | 202 | 198 | 195 | 193 | 191 | 188 | 185 | 181 | 179 | 173 | 171 | 168 | 165 | 163 | 162 |
| 57 | 196 | 196 | 194 | 192 | 190 | 187 | 185 | 183 | 182 | 179 | 175 | 173 | 171 | 167 | 164 | 162 | 159 | 157 | 155 |
| 60 | 180 | 180 | 184 | 182 | 180 | 178 | 176 | 174 | 173 | 171 | 170 | 168 | 168 | 168 | 168 | 168 | 168 | 168 | 168 |
| 63 | 181 | 179 | 177 | 175 | 173 | 170 | 168 | 166 | 165 | 163 | 160 | 158 | 156 | 154 | 151 | 149 | 146 | 144 | 142 |
| 66 | 174 | 171 | 169 | 167 | 165 | 162 | 160 | 158 | 156 | 154 | 152 | 151 | 150 | 148 | 146 | 144 | 142 | 140 | 138 |
| 69 | 169 | 166 | 163 | 161 | 160 | 159 | 158 | 156 | 154 | 152 | 150 | 148 | 147 | 146 | 144 | 141 | 139 | 137 | 135 |
| 72 | 163 | 161 | 158 | 156 | 153 | 151 | 150 | 148 | 146 | 145 | 143 | 142 | 141 | 139 | 137 | 136 | 134 | 132 | 130 |
| 75 | 157 | 155 | 152 | 150 | 147 | 145 | 144 | 142 | 140 | 139 | 138 | 137 | 135 | 134 | 132 | 130 | 129 | 126 | 124 |
| 78 | 151 | 149 | 146 | 144 | 141 | 139 | 138 | 136 | 134 | 133 | 132 | 131 | 130 | 128 | 126 | 123 | 121 | 118 | |
| 81 | 146 | 143 | 140 | 138 | 135 | 133 | 131 | 129 | 128 | 127 | 126 | 125 | 124 | 122 | 120 | 118 | 115 | | |
| 84 | 141 | 138 | 135 | 132 | 129 | 128 | 127 | 126 | 125 | 124 | 123 | 122 | 120 | 118 | 115 | | | | |
| 87 | 136 | 133 | 130 | 127 | 124 | 122 | 121 | 119 | 118 | 117 | 115 | 112 | 114 | 113 | | | | | |
| 90 | 132 | 128 | 125 | 122 | 121 | 119 | 118 | 116 | 115 | 114 | 113 | 111 | | | | | | | |
| 93 | 127 | 124 | 122 | 119 | 118 | 116 | 115 | 113 | 112 | | | | | | | | | | |
| 96 | 124 | 121 | 119 | | | | | | | | | | | | | | | | |
| 99 | 120 | 118 | 116 | 114 | 112 | | | | | | | | | | | | | | |
| 102 | 117 | 115 | | | | | | | | | | | | | | | | | |

SHADED PART SHOWS APPROX
AREA OBSTRUCTED DUE TO
DOOR OPENING LINKAGE.



WELLY CARVED DOORS

| Width Inches | | WEIGHT IN POUNDS | | | | | | | | | | | | | | | | |
|-----------------|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|
| | | WEEDER LENGTHS - INCHES | | | | | | | | | | | | | | | | |
| | | 6 | 8 | 12 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | |
| 3 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 150 | 145 | 132 | 127 | 121 | 120 | 119 | 112 | 105 | 97 | 91 |
| 9 | 160 | 160 | 160 | 160 | 160 | 160 | 150 | 147 | 141 | 125 | 120 | 121 | 119 | 112 | 105 | 97 | 91 | 82 |
| 12 | 160 | 160 | 160 | 150 | 145 | 135 | 129 | 124 | 119 | 115 | 109 | 106 | 101 | 97 | 92 | 87 | 81 | 74 |
| 15 | 160 | 160 | 142 | 127 | 127 | 110 | 114 | 109 | 103 | 98 | 91 | 84 | 82 | 79 | 73 | 67 | 60 | 54 |
| 18 | 160 | 150 | 123 | 111 | 111 | 100 | 103 | 98 | 91 | 87 | 81 | 74 | 71 | 66 | 61 | 54 | 48 | 42 |
| 21 | 124 | 116 | 100 | 90 | 95 | 84 | 90 | 87 | 84 | 82 | 79 | 74 | 71 | 66 | 61 | 54 | 48 | 42 |
| 24 | 117 | 104 | 90 | 81 | 88 | 80 | 84 | 81 | 79 | 76 | 74 | 71 | 66 | 61 | 54 | 48 | 42 | 36 |
| 27 | 99 | 95 | 89 | 82 | 79 | 70 | 77 | 74 | 72 | 70 | 67 | 60 | 64 | 64 | 57 | 49 | 42 | 36 |
| 30 | 80 | 80 | 70 | 70 | 68 | 67 | 66 | 64 | 64 | 62 | 60 | 57 | 54 | 53 | 45 | 41 | 36 | 30 |
| 33 | 80 | 70 | 70 | 70 | 68 | 67 | 66 | 64 | 64 | 62 | 60 | 57 | 54 | 53 | 45 | 41 | 36 | 30 |
| 36 | 71 | 71 | 60 | 64 | 64 | 62 | 61 | 59 | 58 | 56 | 53 | 50 | 48 | 42 | 38 | 34 | 30 | 24 |

NOTE: Maximum length of forward compartment - 130 inches. Packages longer than 130 in. can be loaded in the aft compartment only. This is indicated by dotted line.

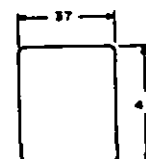


FIGURE 19. Sample maximum package size data (for cargo transport aircraft only).

MIL-W-25140B

MISCELLANEOUS DATA
CREW, PASSENGER AND LITTER CENTROIDS

| COMPT | CREW | | PASSENGER | | LITTER | |
|-------|---|-------------------|----------------|----------------------|----------------|---------------------|
| | Crew Member | Arm | Row No. | Arm | Tier No. | Arm |
| B | Pilot & Co-Pilot Flight Engineer Radio Operator | 190 222 226 | | | | |
| D | Navigator Relief Crew | 308 329 | | | | |
| E | Relief Crew | 407 | 1 2 | 390 427 | 1 2 3 | 428 428 448 |
| F | | | 3 4 | 464 501 | | |
| G | | | 5 6 | 538 574 | 4 5 6 | 525 526 539 |
| H | | | 7 8 | 611 648 | 7 8 9 | 620 623 636 |
| I | | | 9 10 | 685 722 | 10 | 715 |
| J | | | 11 12 | 758 795 | 11 12 | 736 769 |
| K | | | 13 14 | 832 869 | 13 14 15 | 810 834 861 |
| L | | | 15 16 | 906 942 | 16 17 | 905 932 |
| M | | | 17 18 | 976 1016 | 18 19 20 | 955 1000 1029 |
| N | Stewards or Attendants | 1096 1134 | 19 20 21 | 1053 1090 1126 | | |

DIMENSIONAL DATA

| | |
|-----------------------|--------------|
| Span | 117 ft |
| Length | 115 ft 8 in. |
| Maximum height over | |
| fin - static altitude | 30 ft 2 in. |
| - level altitude | 32 ft 5 in. |
| Approx. wheel base | 42 ft 5 in. |
| Approx. tread | 28 ft 3 in. |

FIGURE 20. Sample miscellaneous data.

MIL-W-251403

| TYPICAL SERVICE LOAD CONDITIONS | | | | | | | | | | | |
|-------------------------------------|-------|--------|-------------|----------|-------------|--------|-------------|----------------|-------------|----------------|-------------|
| ITEM | ARM | NORMAL | | OVERLOAD | | COMBAT | | FIGHTER BOMBER | | ROCKET FIGHTER | |
| | | WEIGHT | MOM 1000 | WEIGHT | MOM 1000 | WEIGHT | MOM 1000 | WEIGHT | MOM 1000 | WEIGHT | MOM 1000 |
| Pilot and Chute | 140.0 | 200 | 28 | 200 | 28 | 200 | 28 | 200 | 28 | 200 | 28 |
| Parachute and Seat Pan | 142.1 | 26 | 4 | 26 | 4 | 26 | 4 | 26 | 4 | 26 | 4 |
| Fuel (at 6 lb/gal) | | | | | | | | | | | |
| Main683 Gal | 209.6 | 4098 | 859 | 4098 | 859 | | | 4098 | 859 | 4098 | 859 |
| Main354 Gal | 209.0 | | | | | 3324 | 695 | 1440 | 331 | 1440 | 331 |
| Tip Tank.....240 Gal | 230.1 | | | | | | | 172 | 46 | 172 | 46 |
| Water (at 7.64 lb/gal). 22.5 Gal | 268.0 | | | 172 | 46 | | | | | | |
| Ammunition - 20mm | | | | | | | | | | | |
| Inboard Guns...380 Rd | 68.6 | 236 | 16 | 236 | 16 | 236 | 16 | 236 | 16 | 236 | 16 |
| Outboard Guns .380 Rd | 139.7 | 236 | 33 | 236 | 33 | 236 | 33 | 236 | 33 | 236 | 33 |
| Bullet (in lieu of ammunition) | 60.2 | | | | | | | | | | |
| Rockets | | | | | | | | | | | |
| 6 - 5 In. HVAR | 218.2 | | | | | | | | | 840 | 183 |
| 2 - 6 Shot 5 In. HPAG Packages | 223.0 | | | | | | | | | 2000 | 446 |
| Bombs | | | | | | | | | | | |
| 6 - 250 lb G.P. | 217.1 | | | | | | | 1312 | 328 | | |
| 2 - 500 lb G.P. | 223.0 | | | | | | | 1090 | 243 | | |
| Sway Braces - Astro - IA | 223.8 | | | | | | | 47 | 11 | 47 | 11 |
| Totals | | 4796 | 940 | 6408 | 1317 | 4022 | 776 | 9057 | 1899 | 9295 | 1957 |
| | | | | | | | | | | 4575 | 908 |

FIGURE 21. Sample typical loading for class 1A and 1B aircraft.

MIL-W-25140B

d. When minor changes in either Chart A or E and reprinting becomes necessary subsequent to initial approval, the contractor shall redate the page(s) of the chart(s) affected and change the Chart Date on page 1 to agree. A copy of all revised pages plus three prints of the complete chart(s) shall be forwarded to the procuring activity as soon as possible, but not later than 1 week after the date of actual insertion in handbooks of the aircraft affected. A list of differences over the previous issue of the charts, the reason therefore, a summary of the latest revision dates of the pages which comprise the chart(s), the serial number of the first aircraft affected, and when only one chart is affected, the "chart date" of the other remaining in effect, shall also be furnished. The revised charts may be considered satisfactory unless otherwise advised by the procuring activity.

e. If important or extensive corrections of the Charts A and E, or major changes to the aircraft, warrant replacement of pages of the Charts A and E (or the complete Chart E, if appropriate) in the Weight Handbooks of aircraft already delivered, the procedure outlined in paragraph d above shall be applied and printed copies also furnished as indicated below:

(1) When c.g. limits based on procuring activity tests are furnished to supersede limits based on contractor tests or calculations, copies of the revised Chart E c.g. data shall be furnished to the local representative of the procuring activity for distribution directly to all operating activities affected, with appropriate instructions to the operating activities concerning the replacement of Chart E in the Weight Handbooks.

(2) When contractor-furnished service bulletins and parts kits involve major changes to be incorporated by operating activities and necessitate extensive corrections or additions to the Charts A and E (such as new fuel or ammunition tables for added or relocated tanks or guns, new compartment tables for increased floor strength, etc.), copies of the revised Charts A and E data shall be included in the parts kits, and appropriate instructions concerning the replacement of Charts A and E in the Weight Handbook included in the instructions for accomplishing the change.

(3) When errors are detected in the Charts A and E which materially affect the accuracy of the weight and c.g. calculations, the procedure of (1) above shall be applied.

f. When major changes involving a change in model designation are concerned, the procedure for initial approval specified in paragraphs a, b, c shall apply.

MIL-W-25140F

3.7.10 Balance computer design data. For class 2 aircraft for which a balance computer is to be furnished, the procuring activity (if the computer is GFAE) or the aircraft contractor (if the computer is CPE) will forward one copy of the approved Charts A and E to the balance computer manufacturer for use as design data. The following information shall be furnished in duplicate with the charts:

a. Anticipated minimum and maximum basic weights, and most forward and aft basic weight c.g. locations, assuming removal of equipment for a minimum stripped condition and addition of specified special equipment for a maximum equipped condition.

b. When fuel and oil moment arms vary with fuel quantity, a table or graph of the variation in arm from empty to full tank(s) upon which the Chart E fuel and oil tables are based.

3.7.10.1 Release of balance computer designs. A sample faceplate to the proposed balance computer will be furnished to the procuring activity as well as to the aircraft contractor, who shall furnish comments to the procuring activity in duplicate as soon as possible on the completeness and conformance of the sample design with the balance computer design data, and any other subsequently available information on the aircraft. Comments of the contractor and the procuring activity will be coordinated and forwarded to the balance computer manufacturer by the procuring activity. In the event that the comments require revision of the design, samples and further comment shall be handled as above, except that when minor changes are involved, comments and final release will be handled by the procuring activity.

3.8 Balance calculations.

3.8.1 General. Balance calculations, as required for the respective weight reports, shall be prepared in tabular form with groups listed in the order shown on the weight statements (MIL-STD-1374, Parts I and II). Weights, arms, and moments shall be given in detail, with totals for each subgroup and group. Equipment groups (e.g., Electrical, Armament, Air Conditioning, etc.) shall be broken down to list "installations" and major components comprising these installations. Each engine, propeller, tank, etc., shall be listed separately, unless the same moment arm applies. The horizontal and vertical moment axes shall be so located that all moments will be positive. The axes shall be dimensioned from convenient fixed points on the body. Arms and moments for all weight report and the Weight Handbook shall be in inches and pound-inches, except that subject to prior approval by the procuring activity feet and pound-feet may be used for extremely large aircraft.

MIL-W-25140B

3.8.2 Lateral center of gravity. These data are required unless specifically waived by the procuring activity. Detailed calculations shall be included in the Detail Weight Reports (Estimated, Calculated, First, and Last Aircraft) to show the lateral unbalance and the loading limitations or cautions necessary to control lateral distribution of load. A scale for determining lateral dimensions shall be included on the appropriate structural diagrams in the weight reports. The requirements of paragraphs 3.7.1b, 3.7.9.5.15 and 3.8 shall apply to lateral center of gravity limits, lateral center of gravity data and lateral balance calculations respectively.

3.8.3 Most forward and most aft center of gravity conditions. For classes 1A and 1B aircraft, these calculations are intended to determine the extreme c.g. positions attainable. For class 2 aircraft, these calculations are intended to determine the extreme c.g. positions which may occur using reasonable care in crew shifting, bomb drop sequence, fuel management, cargo, placement, etc. Such calculations will demonstrate that the c.g. can be maintained within the permissible c.g. range, and also will serve the purpose of determining what "cautions," "special instructions," etc., may be desirable to insure that operating activities know how to achieve proper balance or how to avoid the critical conditions. The most forward and most aft calculations shall show the extreme c.g. positions which may result from each of the following:

a. Any specified load condition, considering partial or complete expenditure of any expendable useful load items and necessary crew movement from normal flight stations to takeoff, landing, battle, or ditching stations.

b. The extremes of the above plus the most critical combination of special or alternate load items.

c. For personnel transport aircraft, assume full row seating in the most adverse manner to give extreme c.g. attainable. If these are outside the permissible c.g. range, show seating restrictions required. Where baggage is included and alleviates the critical loading, the condition of "no baggage carried" shall also be shown.

d. For cargo aircraft, determine most adverse distribution of cargo that can be carried and still maintain loadings within the permissible c.g. range. The calculations will be indicative of the degree of loading control needed within the load-carrying capacity of the aircraft, and demonstrate that, with rational distribution of cargo, the permissible cargo loads can be utilized within the permissible aircraft c.g. range.

MIL-W-251403

3.8.4 Lighting gear. Weight empty and basic weight c.g. locations shall be calculated in weight reports with lighting gear extended. Gross weight c.g. locations shall be calculated in weight reports with lighting gear extended and retracted. For calculations deriving the moment change for retraction of the lighting gear, moving and stationary items shall be listed separately.

3.8.5 Armament variables. For guns fed from a remote source, ammunition in feed chutes shall be listed separately. In the extreme balance calculations, the effect of empty cases and links shall be included when provision is made for retaining them in the aircraft. Partial loading or expenditure of stores, rockets, etc., in the most critical sequence, or in accordance with the operating sequencing instructions to be prescribed in the Flight Handbook, shall be considered when these items can be carried in more than one bay or on several stations.

3.8.6 Fuel variables. Quantities in each tank shall be listed as separate items unless the same moment arm applies. When tanks are interconnected to fill and drain as a single tank, weights, arms, and moments shall be listed for each tank and for the total quantity in the interconnected tanks. When more than one type of fuel is provided for, supplementary calculations based on nominal fuel weights shall be included for the alternate fuels. If variation in fuel density materially affects the extreme c.g. locations attainable, the effect of a density variation of +0.6 pound/gallon from the nominal weight shall also be shown. If an extreme c.g. position will result with fuel tanks approaching an empty condition, the fuel shall be considered as totally consumed. Where emergency manual selection of tanks is provided on automatic sequencing systems, the extremes that could be encountered by adverse emergency selection shall also be indicated. The following information, as appropriate, shall be included in the Detail Weight Reports (Estimated, Calculated, First and Last Actual) where necessary to explain the fuel filling and consumption sequence and to substantiate the distribution assumed for the gross weight and extreme balance conditions:

a. Reason for or justification of the distribution assumed in the calculations, if the distribution is not automatically controlled and is not obviously the most critical attainable. This may consist of a statement of the filling and consumption sequences to be prescribed in the fuel system management instructions in the Flight Handbook, or that fuel usage must be controlled by pilot for balance control.

b. Brief description of system operation, if automatic distribution by single point fueling or automatic consumption sequence is provided. Include schematic diagrams outlining fuel system arrangement, brief explanation of distribution and sequencing features, and graphs showing distribution as system is filled and fuel is consumed. Where extreme attitudes in prolonged climb and descent materially affect the distribution, include sufficient information on the effect of attitude to permit evaluation of the attainable extreme aircraft c.g. location.

MIL-W-25140B

3.8.7 Oil variables. When multitank or automatic distribution, transfer or feed system are provided, the applicable requirements of 3.8.6 shall be applied. Oil consumption may be neglected in extreme balance calculations unless total oil consumption will affect the attainable extreme c.g. locations by more than 0.5 percent MAC for aircraft, or 0.5 inch for rotorcraft. Rational assumptions of rate of consumption shall be made when it is necessary to consider expenditure of oil.

3.8.8 Miscellaneous variables. If "placards," which restrict the installation or combination of items, are to be installed in the aircraft, the proposed or actual location and wording shall be stated in the weight reports and the attainable extreme c.g. conditions may be based on assuming compliance with these placards. Partial installation of de-icer boots on wings, tail, and other surfaces need not be considered.

3.8.9 Tank capacities. When calibration of the fuel tanks has been completed, loading conditions which are based on full tank(s) shall be adjusted in the next weight report furnished, based on the actual capacities, and footnotes to this effect shall be made on the weight report. If the difference over the estimated fuel capacity is large, oil shall be adjusted based on the specified fuel/oil ratio. When calibration of the oil tank(s) has been completed, any difference between the estimated and actual capacity shall be noted specifically in the next weight report furnished.

3.9 Weighings.

3.9.1 General. Weighings shall provide for the determination of the weight empty, except that for instrumented flight test aircraft, weighings may determine as-delivered weight. It is preferable to make all weighings with the aircraft completely assembled and in the dry condition (before the fuel and oil systems have been filled). However, the first aircraft to be weighed on the contract shall be weighed in the dry condition. Aircraft with alternate lighting gear may be weighed in any one of the alternate lighting gear conditions. Weights shall be determined by taking the average of three independent readings (e.g. for beam scales by upsetting the beams of all scales between readings, or completely unloading the electronic load cells). Approval of the weighing procedures must be obtained from the procuring activity prior to the weighing.

3.9.2 Scales. The scales are to be calibrated or certified correct by Government or commercial scale officials satisfactory to the contractor and the Government Inspector at least once every year. Scale calibration periods may be modified as specifically requested by the procuring activity.

MIL-W-25140B

3.9.3 Center of gravity determination. Weighings shall provide horizontal c.g. locations as required on the approved weighing forms. The vertical c.g. locations shall be determined by calculation. When specifically requested by the procuring activity, the vertical c.g. shall be determined as required by Form AN-9250. Lateral c.g. locations shall be determined when specifically requested by the procuring activity.

3.9.4 Trapped fuel and oil. Trapped fuel and trapped oil are defined as the amounts of fuel and oil remaining in the respective systems when oil is drained and the aircraft is defueled in static, ground attitude (seaplane on beaching gear) by the normal means provided for draining the tanks. The data are intended to establish a baseline for reweighing of aircraft and determination of weight empty or basic weight. Unless otherwise specified, the weights of trapped fuel and oil shall be determined on the first aircraft, and on a representative aircraft each time a change is made in the fuel and oil systems which will cause an appreciable change in the trapped fuel and oil data. The data shall be obtained in the manner indicated below, starting with an aircraft with completely dry systems (i.e., before any fuel or oil is placed in tanks). For aircraft with alternate alighting gears, trapped fuel and oil for the alternate alighting gear conditions shall be furnished; the data for the conditions not determined by actual weighing may be based on analysis and calculations to account for any material differences caused by attitude, float tanks, outlet locations, etc. Diagrams or sketches shall be included to identify specifically the drain points and their physical location. The distribution of the trapped quantities shall be rationally determined by calculating or estimating the quantities in the major components of the system (engine, oil coolers, tank sumps, etc.) to determine their weights, arms, and moments. These data shall be tabulated to show the derivation of the weights, arms, and moments for the totals of trapped fuel and trapped oil.

a. Trapped fuel:

(1) Add a measured weight of fuel into each tank. Where single point fueling is provided, insure that sufficient fuel is added to permit circulation to all tanks and plumbing.

(2) Operate fuel pumps to insure filling of all fuel lines. Do not operate the engine.

(3) Using only the normal means provided for defueling the aircraft, drain the fuel into containers. Weigh the containers before and after draining. Aircraft which have transfer tanks or separate long-range tank systems may in some cases not drain as completely in ground attitude as in flight. Where the pattern of previous missions and subsequent defueling would result in material differences in trapped fuel, include a determination of this difference with appropriate explanation.

(4) The trapped fuel is then the difference between the weights of fuel measured in (1) and (3).

MIL-W-25140B

b. Trapped oil:

(1) Determine the weight of engine preoiling oil. Pour a measured weight of oil into each tank.

(2) Operate the engine the minimum length of time necessary to insure that the oil has circulated.

(3) Using only the drains provided for the oil tanks (usually the sump drains), drain the oil into a container. Weigh the container before and after draining.

(4) The trapped oil is then the difference between the weights of oil measured in (1) and (3).

3.10 Measuring and leveling provisions.

3.10.1 Application. The following paragraphs cover the general requirements for measuring and leveling provisions for use when weighing aircraft, when aligning fixed guns, or when structural alignment is being made on aircraft.

3.10.2 Measuring provisions. Each aircraft shall be provided with jig points for taking measurements during weighing and alignment. Each jig point shall consist of a hole or fitting, located such that it is a known distance ± 0.06 inches from all reference datums for the aircraft concerned. These measuring provisions shall cause no increase in drag when not in use. Each jig point shall be appropriately labeled so that its position on the aircraft may readily be determined. As a minimum, jig points shall be on the fuselage and wings if the aircraft has such. Jig points not on the centerline of the aircraft shall be symmetrically located on each side of the aircraft. The fuselage shall have jig points forward and aft of the wing. Each jig point shall be located such that nothing will interfere with dropping a plumb line to the hangar floor.

3.10.3 Leveling provisions. Each aircraft shall be furnished with the provisions specified herein for obtaining the true level attitude of the longitudinal and lateral axes of the aircraft while the aircraft is being weighed, while structural alignment is being made, or while fixed guns are being aligned. When provisions for leveling the aircraft or weighing or for structural alignment are not suitable for use in aligning fixed guns, a second set of leveling provisions shall be furnished for that purpose and marked "GUN LEVEL". All leveling provisions shall be clearly listed.

MIL-W-25140B

3.10.3.1 Plumb bob. Provisions shall be made, as further specified below, for a plumb line swinging at a radius of not less than two feet within the aircraft, and in such a position that the relation between the plumb line or the point of the plumb bob and a graduate plate can be seen closely and without personnel entering or climbing on the aircraft. Subject to specific approval of the Procuring Agency, leveling personnel will be permitted aboard extremely large aircraft, the weights of which are such that leveling accuracy will not be impaired by minor movements of leveling personnel. In this latter case, provisions for leveling shall be readily accessible, shall be as near the center of gravity as practicable.

3.10.3.1.1 Upper bracket. An upper jig-located bracket shall be attached to structural members of the aircraft in such a position that a plumb line can be suspended therefrom. The bracket shall be designed in such a manner that the plumb line will always be suspended from the same point, and will be positioned with unvarying accuracy as related to the leveling plate or plates located below the bracket.

3.10.3.1.2 Lower plate. A metal plate or plates shall be permanently attached to some structural part of the aircraft below the upper bracket specified above. The lower plate or plates shall be positioned so that when a plumb line is suspended from the upper bracket either a portion of the plumb line or the point of the plumb bob will fall sufficiently close to the graduations on the plate or plates to permit easy reading of the indicated attitude. The graduations in degrees and minutes shall be permanently inscribed on the plates and shall provide for indicating the following aircraft attitudes:

- a. Longitudinally and laterally level
- b. Normal static ground attitudes between three degrees forward of the most nose down attitude to three degrees aft of the most tail down attitude, and laterally level
- c. The attitudes for structural alignment and gun alignment if different from paragraph (a) above.

3.10.3.2 Leveling lugs. For aircraft not sufficiently large for use of the leveling aids previously specified, other leveling provisions as specified below shall be installed.

3.10.3.2.1 Two jig-located fittings shall be placed 10 to 20 inches apart on some primary structure of the aircraft. The fittings shall provide an ample firm support upon which to place a spirit level, and shall be so located as to give a true level reading and be accessible for leveling the aircraft. Similar provisions shall be made for laterally leveling the aircraft, preferably near the location of the longitudinal leveling fittings. All fittings shall be located so that personnel can take leveling readings without getting into or climbing on the aircraft, and may be located within the wheel well, door entrance or similar enclosures, or external to the aircraft.

MIL-W-25140B

3.11 Weights.

3.11.1 GFAE weight. The contract/guaranteed weight empty is based on the weights of the GFAE listed in the contract detail specification as modified by specified weights of GFAE added by contract changes. Any overweight or underweight owing to addition, deletion, variation, or change of a Government-furnished item for which allowance has not been made in a contract change shall be considered as revising the contract/guaranteed weight empty accordingly.

3.11.2 Overweight and underweight.

a. Preproduction contracts: Unless otherwise specified, for preproduction contracts, the overweight and underweight shall be based on the actual weight, as determined by the weighings made upon completion of the aircraft, plus the weight incident to the incorporation if all changes and modifications (actually installed) found necessary to fulfill the requirements of the specifications and the amended contract for acceptance of the aircraft. The contractor shall establish an appropriate system for the recording of all modifications made subsequent to the weighings, together with their effect on weight and balance; this shall cover the periods during preliminary flights, procuring activity tests, etc., up to the time when the aircraft is finally accepted. The weight empty given in the original weight report and revised by the data in the appendices shall serve as the basis for the determination of the overweight or underweight. If the contract provides for more than one aircraft, the overweight or underweight shall be taken as the average of the overweight or underweight values for the aircraft as finally accepted and shown in the required actual weight data.

b. Production contracts: For production contracts, the overweight or underweight shall be taken as the average of the overweight and underweight values shown by the required actual weight data. Refer to paragraphs 3.7.4, 3.7.5 and 3.7.8.

3.11.3 Engine.

a. Dry weight: The items included in the dry weight of the engine shall be those defined in the applicable engine model specification. The engine dry weight entered in the engine log by the engine manufacturer may be used as a basis for determining the "as installed" weight for all but the Actual Weight Report - First Aircraft and the first aircraft equipped with an engine having a new model designation.

b. Estimated weight: The estimated "as installed" weight of engines shall be the specified dry weight plus an allowance as follows for the oil and grease contained in the engine:

| | |
|----------------|-----------|
| Reciprocating | 15 pounds |
| Turbopropeller | 10 pounds |
| Turbojet | 5 pounds |

c. **Actual weight:** The actual "as installed" engine weight shall be that weight obtained when the engine, including all dry weight items, is cleaned up and ready for installation in the aircraft.

4. QUALITY ASSURANCE PROVISIONS

4.1 Methods of inspection and approval.

4.2 General. The Government Inspector shall certify to the correctness of all actual weight data submitted to the Government and shall witness actual weighings and sign the official weighing form. The Inspector shall also comment in appropriate detail on all weight estimates and discussions submitted in correspondence concerning proposed contract changes or amendments.

4.3 Final approval. Final approval shall be obtained from the activity under which procurement is made.

5. PREPARATION FOR DELIVERY

5.1 Packaging and packing. Weight and balance control data shall be packaged in such manner that it will not be damaged in transit by common carrier.

5.2 Delivery. Shall be as directed by the procuring activity.

5.3 Marking of shipments. There are no requirements for the marking of the packages containing weight and balance control data.

6. NOTES AND CONCLUDING MATERIAL

6.1 Intended use. The specification is used in the management of Weight and Balance Control Systems and in determining compliance with contractual requirements during design and construction of aircraft.

6.2 Ordering data. Procurement Documents should specify the following:

a. Title, Number, and Date of this specification.

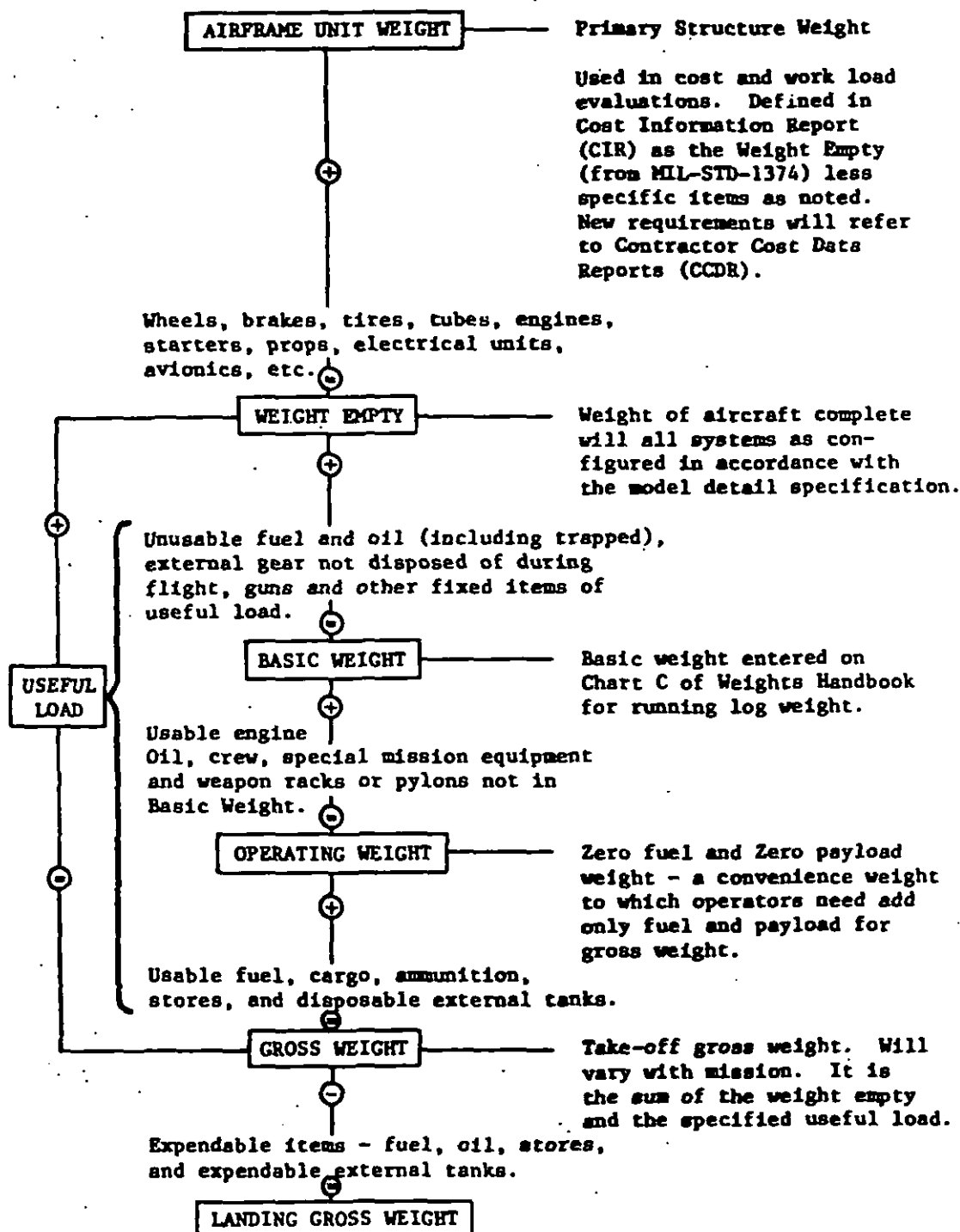
6.2.1 Procurement requirements. Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.

MIL-W-25140B

6.2.2 Contract data requirements. Items of deliverable data required by this specification are cited in the following paragraphs:

| Paragraph | Data Requirement | Applicable DID | | |
|------------------|---|-----------------------|-----------|--------------|
| | | Air Force | Army | NAVAIR |
| 3.2 | Weight Control Management Program Plan Report | DI-S-3572/ S-149-1 | DI-E-1124 | |
| 3.3.1 | Specification Weight Derivation | | | UDI-S-21189 |
| 3.3.2 | Post-Design Weight Analysis | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-S-21188 |
| 3.7.1 | Weight & Balance Status | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-S-21184 |
| 3.7.2 | Estimated Weight Report | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-S-21183 |
| 3.7.3 | Calculated Weight Report | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-S-21185 |
| 3.7.4 | Actual Weight Report (Detail) | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-S-21187 |
| 3.7.5 | Actual Weight Report (Intermediate) | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-S-21181A |
| 3.7.6 & 3.7.7 | Appendix to Actual Weight Reports | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-S-21187 |
| 3.7.8 | Actual Weight Report (Last) | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-S-21187 |
| 3.7.9 | Handbook of Weight and Balance | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-M-21186 |
| 3.7.10 | Balance Computer Design Data | DI-S-3584/ S-103-2 | DI-E-1124 | UDI-M-21186 |
| 3.6.3 | Engineering Change Proposal (ECP) | | DI-E-1124 | |
| 3.6.5 | Aircraft Modification - Prior to Service | DI-S-3584/ S-103-2 | DI-E-1124 | |
| 3.6.6 | Aircraft Modification - Return from Service | DI-S-3584/ S-103-2 | DI-E-1124 | |

Such data will be delivered as described on approved (numbered) DIDs (Data Item Description DD Form 1664) when specified on DD Form 1423 (Contract Data Requirements List) and incorporated into the applicable contract.

6.2.3
Handbooks.Weight definitions. As used in MIL-STD-1374 and Weight

MIL-W-251408

6.3 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:

Navy - AS
Air Force - 11
Army - AV

Preparing Activity:

Navy - AS
Project No. 1500-0093

NUMERICAL INDEX

| | | Page |
|------------|---|------|
| Section 1. | SCOPE | 1 |
| Section 2. | APPLICABLE DOCUMENTS | 1 |
| 2.1 | Issues of documents | 1 |
| Section 3. | REQUIREMENTS | 3 |
| 3.1 | General | 3 |
| 3.2 | Weight and balance control system | 3 |
| 3.3 | Submittal of data | 3 |
| 3.3.1 | Specification weight derivation | 3 |
| 3.3.2 | Post design weight analysis report | 4 |
| 3.4 | Weight and balance classification | 5 |
| 3.4.1 | Class 1A | 5 |
| 3.4.2 | Class 1B | 5 |
| 3.4.3 | Class 2 | 5 |
| 3.4.4 | Classification assignment | 5 |
| 3.5 | Handbooks and balance computers | 5 |
| 3.5.1 | Class 1A aircraft | 5 |
| 3.5.2 | Class 1B aircraft | 5 |
| 3.5.3 | Class 2 aircraft | 5 |
| 3.6 | Weight and balance data | 5 |
| 3.6.1 | Preproduction contract | 5 |
| 3.6.2 | Production contract | 7 |
| 3.6.3 | Engineering Change Proposals (ECP's) | 9 |
| 3.6.4 | Amended preproduction and production contract | 11 |
| 3.6.5 | Contract for modification of new classes 1A, 1B, and 2 aircraft subsequent to acceptance and prior to service | 11 |
| 3.6.6 | Contract for modification of classes 1A, 1B, and 2 aircraft returned from service | 12 |
| 3.7 | Preparation of data | 12 |
| 3.7.1 | Weight and Balance Status Report | 12 |
| 3.7.2 | Estimated Weight Report | 14 |
| 3.7.3 | Calculated Weight Report | 17 |
| 3.7.4 | Actual Weight Report - First Aircraft | 19 |
| 3.7.5 | Actual Weight Report - Intermediate Aircraft | 21 |
| 3.7.6 | Appendices to Actual Weight Reports required prior to conducting procuring activity tests | 23 |
| 3.7.6.1 | Appendix to Actual Weight Report representative of the block | 23 |
| 3.7.6.2 | Appendix for instrumented aircraft | 24 |
| 3.7.7 | Final appendices to Actual Weight Reports | 25 |
| 3.7.8 | Actual Weight Report - Last Aircraft | 25 |

MIL-W-25140B

NUMERICAL INDEX (continued)

| | Page |
|---|------|
| 3.7.9 Handbook, Weight and Balance Data, (Classes 1B and 2 aircraft) | 27 |
| 3.7.9.1 General | 27 |
| 3.7.9.2 Chart A, Form DD-365A | 29 |
| 3.7.9.3 Weighing Form, Form DD-365B | 34 |
| 3.7.9.4 Chart C, Form DD-365C | 34 |
| 3.7.9.5 Chart E | 35 |
| 3.7.9.5.1 Weighing instructions | 35 |
| 3.7.9.5.2 Aircraft diagram | 37 |
| 3.7.9.5.3 Fuel and oil loading data | 43 |
| 3.7.9.5.4 Water injection fluid data | 43 |
| 3.7.9.5.5 Stores loading data | 45 |
| 3.7.9.5.6 Ammunition loading data | 45 |
| 3.7.9.5.7 Rocket projectile loading data | 45 |
| 3.7.9.5.8 Camera loading data for photographic aircraft | 45 |
| 3.7.9.5.9 Assisted takeoff (ATO) data | 45 |
| 3.7.9.5.10 Compartment loading data for class 2 aircraft | 49 |
| 3.7.9.5.10.1 Cargo transport types | 49 |
| 3.7.9.5.10.2 All other types | 51 |
| 3.7.9.5.10.3 Basis for compartment capacities centroids | 51 |
| 3.7.9.5.11 Cargo tiedown data for class 2 cargo types | 51 |
| 3.7.9.5.12 Passenger, troop, and litter data | 53 |
| 3.7.9.5.13 Personnel movement data | 53 |
| 3.7.9.5.14 Miscellaneous equipment data | 53 |
| 3.7.9.5.15 Center of gravity data | 53 |
| 3.7.9.5.16 Maximum package size data (for cargo transport aircraft only) | 60 |
| 3.7.9.5.17 Miscellaneous data | 60 |
| 3.7.9.5.18 Typical loadings | 60 |
| 3.7.9.6 Approval of Charts A and E | 60 |
| 3.7.10 Balance computer design data | 65 |
| 3.7.10.1 Release of balance computer designs | 65 |
| 3.8 Balance calculations | 65 |
| 3.8.1 General | 65 |
| 3.8.2 Lateral center of gravity | 66 |
| 3.8.3 Most forward and most aft center of gravity conditions | 66 |
| 3.8.4 Alighting gear | 67 |
| 3.8.5 Armament variables | 67 |
| 3.8.6 Fuel variables | 67 |
| 3.8.7 Oil variables | 68 |
| 3.8.8 Miscellaneous variables | 68 |
| 3.8.9 Tank capacities | 68 |

NUMERICAL INDEX (continued)

| | | Page |
|------------|---------------------------------------|------|
| 3.9 | Weighings | 68 |
| 3.9.1 | General | 68 |
| 3.9.2 | Scales | 68 |
| 3.9.3 | Center of gravity determination | 69 |
| 3.9.4 | Trapped fuel and oil | 69 |
| 3.10 | Measuring and leveling provisions | 70 |
| 3.10.1 | Application | 70 |
| 3.10.2 | Measuring provisions | 70 |
| 3.10.3 | Leveling provisions | 70 |
| 3.10.3.1 | Plumb bob | 71 |
| 3.10.3.1.1 | Upper bracket | 71 |
| 3.10.3.1.2 | Lower plate | 71 |
| 3.10.3.2 | Leveling lugs | 71 |
| 3.11 | Weights | 72 |
| 3.11.1 | GFAE weight | 72 |
| 3.11.2 | Overweight and underweight | 72 |
| 3.11.3 | Engine | 72 |
| Section 4. | QUALITY ASSURANCE PROVISIONS | 73 |
| 4.1 | Methods of inspection and approval | 73 |
| 4.2 | General | 73 |
| 4.3 | Final approval | 73 |
| Section 5. | PREPARATION FOR DELIVERY | 73 |
| 5.1 | Packaging and packing | 73 |
| 5.2 | Delivery | 73 |
| 5.3 | Marking of shipments (Not applicable) | 73 |
| Section 6. | NOTES AND CONCLUDING MATERIAL | 73 |
| 6.1 | Intended use | 73 |
| 6.2 | Ordering data | 73 |
| 6.2.1 | Procurement requirements | 73 |
| 6.2.2 | Contract data requirements | 74 |
| 6.2.3 | Weight definitions | 75 |

FIGURES

| | | |
|----------|--|----|
| Figure 1 | Notice to be inserted in the Weight Handbook if Government-furnished balance computers are not received prior to aircraft delivery | 6 |
| Figure 2 | Sample weight and balance breakdown for ECP's | 10 |
| Figure 3 | Sample center of gravity envelope diagram | 16 |
| Figure 4 | Notice to be inserted in the Weight Handbook when an assumed primary operating basic weight condition is entered on Chart C | 28 |

MIL-W-25140B

NUMERICAL INDEX (continued)

| | | Page |
|-----------|---|------|
| Figure 5 | Typical items to be listed on Chart A | 30 |
| Figure 6 | Sample weighing instructions | 36 |
| Figure 7 | Sample aircraft diagram for class 2 aircraft | 39 |
| Figure 8 | Sample aircraft diagram for class 1A and 1B aircraft | 40 |
| Figure 9 | Sample landing gear dimension data | 41 |
| Figure 10 | Sample fuel loading data | 44 |
| Figure 11 | Sample stores loading data for class 2 aircraft | 46 |
| Figure 12 | Sample ammunition, rocket projectile, and stores loading data for class 1A and 1B aircraft | 47 |
| Figure 13 | Sample camera data for photographic aircraft | 48 |
| Figure 14 | Sample compartment loading data for class 2 aircraft (for other than cargo transport types) | 50 |
| Figure 15 | Sample cargo tiedown data for class 2 cargo types | 52 |
| Figure 16 | Sample of passenger and litter data | 54 |
| Figure 17 | Sample personnel movement data for class 2 aircraft | 55 |
| Figure 18 | Sample center of gravity data | 57 |
| Figure 19 | Sample maximum package size data (for cargo transport aircraft only) | 61 |
| Figure 20 | Sample miscellaneous data | 62 |
| Figure 21 | Sample typical loadings for class 1A and 1B aircraft | 63 |

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

☐ VENDOR☐ USER☐ MANUFACTURER☐ OTHER (Specify): _____

3b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

7b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

7c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)