ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

1110.137

7/7/03

SUBJ: AIRCRAFT WEIGHT AND BALANCE CONTROL PROGRAM AVIATION RULEMAKING COMMITTEE

1. PURPOSE. This Order is the charter for the Aircraft Weight and Balance Control Program Aviation Rulemaking Committee. This committee is designated and established by the Administrator's authority under Title 49 of the United States Code (49 U.S.C.), section 106(p)(5).

2. DISTRIBUTION. This Order is distributed to the Associate Administrator for Regulation and Certification, and to the director level in Flight Standards Service; the Office of Rulemaking; Office of the Chief Counsel; and Aircraft Certification Service.

3. BACKGROUND.

a. On January 8, 2003, a Beechcraft 1900D regional commuter airplane experienced a fatal accident on departure. Although the National Transportation Safety Board (NTSB) has yet to determine a probable cause, this accident has raised concerns related to the following:

- Aircraft loading and average weights used in Weight and Balance Control Programs
- Weights depicted in Federal Aviation Administration (FAA) Advisory Circular (AC) 120-27C, Aircraft Weight and Balance Control

b. On January 27, 2003, the FAA issued Notice N 8400.40, Weight and Balance Control Programs for 10 to 19 Seat Airplanes Operated Under 14 CFR 121. This Notice requested all Title 14 of the Code of Federal Regulations (14 CFR) part 121 operators of 10–19 passenger seat airplanes to conduct a survey to validate the average weights in their Weight and Balance Control Programs. The survey was conducted over a consecutive 3-day period (Sunday, Monday, and Tuesday) at 30 percent of each operator's city pairs. Of the routes that were sampled, 15 percent of the flights were surveyed. Upon completion of the survey, the air carriers incorporated any increase noted in the passenger, carry-on, or checked baggage average weight into their Weight and Balance Control Programs. However, some air carriers elected to use actual weights until a full survey could be completed as outlined in AC 120-27C.

c. On March 12, 2003, the air carriers reported the results of their surveys. Twenty percent of the total operators noted that they use actual weights, not average weights, and were exempt from this survey. From the data received, the Flight Standards Service determined the following averages:

Item Weighed	Average Weight	Change from Weight Listed in AC 120-27C
5,940 adult passengers, including one personal item	195.63 pounds	+20.63 pounds
3,819 carry-on bags	15.72 pounds	−5.72 pounds
5,522 checked bags	28.81 pounds	+3.81 pounds

d. One air carrier went a step further and reviewed the pilot medical certificates to derive an average flightcrew weight. It found that the average weight for male pilots was 190 pounds. AC 120-27C lists 180 pounds for male flight crewmembers and 130 pounds for female flight crewmembers.

4. OBJECTIVES AND SCOPE.

a. Initially, the committee will focus on the average weights in AC 120-27C. The FAA proposes to establish a core committee for the AC revision project, and assign work groups to aid the committee.

b. The committee's general goal is to comprehensively review AC 120-27C and related regulations. The advisory and regulatory focus will be on 14 CFR part 121 and 135 operators. This review will consider the amendment history of the AC, NTSB and FAA safety recommendations, accident and incident history, industry dynamics and trends, and other factors impacting the currency, applicability, or safety assessment of the AC. The committee will report its recommendations to the Associate Administrator for Regulation and Certification through the Director of Flight Standards. Its suggestions may include recommendations for rulemaking and additional tasks, including implementation strategies.

c. The committee will make recommendations on the following issues:

(1) Determining whether average weight programs for 10–19 passenger seat aircraft operated under parts 121 and 135 should be eliminated or modified to ensure the highest levels of public safety.

(2) Making a survey to determine the average weight of passengers, checked baggage, carry-on baggage, and personal items for incorporation into AC 120-27C. If operators choose to conduct surveys in accordance with AC 120-27C, they may continue to use their validated average weights after the revised AC is published.

(3) Determining average weights of carry-on baggage checked at the gate and/or planeside.

(4) Handling of special groups.

(5) Determining effect on average weights as they relate to specific routes, specific areas, theaters of operations, island operations, and Alaskan operations.

(6) Addressing seasonal operations (summer v. winter average weights).

(7) Deciding a time interval between surveys/validations of average weights.

(8) Validating male/female ratios and continued use of such ratios in average weight programs.

(9) Achieving international harmonization.

(10) Evaluating the process for approving a weight and balance control program.

(11) Determining how to account for oversized or overweight baggage.

(12) Revising the applicable guidance material.

5. PROCEDURES.

a. The committee provides advice and recommendations to the Director of Flight Standards. The committee acts solely in an advisory capacity.

b. The committee will discuss and present whatever input, guidance, and recommendations its members consider relevant to resolving the issues. Discussion will include, but should not be limited to, the following:

- Operational objectives, recommendations, and requirements
- Recommendations for AC amendments and/or rulemaking necessary to meet objectives
- Guidance material and the implementation strategy and products
- Documentation and technical information to support recommendations

c. Six months from this Order's effective date, the committee will give its first report and written recommendations to the Associate Administrator for Regulation and Certification through the Director of Flight Standards. The committee may make recommendations or complete the tasks before the 6-month due date. Documented issue resolutions, recommended policy decisions, draft guidance material, and/or proposed rulemaking, as appropriate, may be submitted as recommendations.

6. ORGANIZATION AND ADMINISTRATION.

a. The Director of Flight Standards is solely responsible to appoint members or organizations to the committee. The committee will consist of members of the aviation community, including the public and/or other Federal government entities, that represent various viewpoints. The FAA will provide participation and support from all affected lines of business.

b. The Director of Flight Standards is the sponsor of the committee and will select an industry co-chair from the committee membership. The Director also will designate the FAA co-chair for the committee. Once designated, the co-chairs will:

- Determine, in coordination with the other members of the committee, when a meeting is required
- Notify all committee members of the time and place for each meeting
- Form an agenda for and conduct each meeting
- Make certain that detailed minutes are kept for each meeting and certify accuracy of the minutes

c. The committee will submit recommendations and reports to the Director of Flight Standards. The Flight Standards Service will provide administrative support for the committee. It will also provide the chair for this committee. This official will attend all committee meetings.

7. MEMBERSHIP.

a. The FAA will select the core committee membership from approximately six associations and organizations. The membership should be balanced in points of view, interests, and knowledge of the objectives and scope of the committee's tasks. Additional participants may be added as subject matter experts to support sub-committees or work groups, or to provide support to committee members. Each member or participant should represent the identified interest of the affected community.

b. Committee members may include affected aviation associations, air carriers, employee groups or unions, FAA and other government entities, and other aviation industry participants.

8. COST AND COMPENSATION. The estimated cost to the Federal government of the Aircraft Weight and Balance Control Program Aviation Rulemaking Committee (including pro rata share of salaries for FAA employees) is approximately $20,000. Non-government representatives serve without government compensation and bear all costs related to their participation on the committee.

9. PUBLIC PARTICIPATION. Interested persons or organizations who are not committee members but plan to attend a meeting must first get approval from the Director of Flight Standards, or his/her delegate.

10. AVAILABILITY OF RECORDS. Subject to the conditions of the Freedom of Information Act, Section 522 of Title 5 U.S.C., records, reports, agendas, working papers, and other documents given to or prepared by the committee will be available for public inspection and copying at this address: FAA Flight Standards Service, 800 Independence Avenue, SW., Washington, DC 20591. Fees will be charged for information furnished to the public per the fee schedule in part 7 of Title 49 CFR.

11. PUBLIC INTEREST. The formation of the Aircraft Weight and Balance Control Program Aviation Rulemaking Committee is in the public interest in connection with the performance of duties imposed on FAA by law.

12. EFFECTIVE DATE AND DURATION. This committee is effective July 7, 2003. The committee will exist for 2 years, unless sooner terminated or extended by the Administrator.

Marion C. Blakey

Marion C. Blakey
Administrator

involved in any way in determining the relative locations of specific properties with regard to the depicted noise contours, or in interpreting the Noise Exposure Maps to resolve questions concerning, for example, which properties should be covered by the provisions of Section 107 of the Act. These functions are inseparable from the ultimate land use control and planning responsibilities of local government. These local responsibilities are not changed in any way under FAR Part 150 or through FAA's review of Noise Exposure Maps. Therefore, the responsibility for the detailed overlaying of noise exposure contours onto the map depicting properties on the surface rests exclusively with the airport operator which submitted those maps, or with those public agencies and planning agencies with which consultation is required under Section 103 of the Act. The FAA has relied on the certification by the airport operator, under Section 150.21 of FAR Part 150, that the statutorily required consultation has been accomplished.

The FAA has formally received the Noise Compatibility Program for Guam International Airport, effective on May 19, 2003. Preliminary review of the submitted material indicates that it conforms to the requirements for the submittal of Noise Compatibility Programs, but that further review will be necessary prior to approval or disapproval of the program. The formal review period, limited by law to a maximum of 180 days, will be completed on or before November 15, 2003.

The FAA's detailed evaluation will be conducted under the provisions of 14 CFR part 150, section 150.33. The primary considerations in the evaluation process are whether the proposed measures may reduce the level of aviation safety, create an undue burden on interstate or foreign commerce, or be reasonably consistent with obtaining the goal of reducing existing non-compatible land uses and preventing the introduction of additional non-compatible land uses.

Interested persons are invited to comment on the proposed program with specific reference to these factors. All comments, other than those properly addressed to local land use authorities, will be considered by the FAA to the extent practicable. Copies of the Noise Exposure Maps, the FAA's evaluation of the maps, and the proposed Noise Compatibility Program are available for examination at the following locations:

Federal Aviation Administration, National Headquarters, Community and Environmental Needs Division, 800 Independence Avenue, SW., Room 617, Washington, DC 20591.

Federal Aviation Administration, Western-Pacific Region, Airports Division, AWP–600, 15000 Aviation Boulevard, Hawthorne, California 90261.

Federal Aviation Administration, Honolulu Airports District Office, 300 Ala Moana Boulevard, Room 7–128, Honolulu, Hawaii 96813.

Mr. William R. Thompson, Executive Manager, A.B. Won Pat Guam International Airport Authority, 355 Chalan Pasaheru, Tamuning, Guam 96911.

Questions may be directed to the individual named above under the heading, **FOR FURTHER INFORMATION CONTACT.**

Issued in Hawthorne, California on May 19, 2003.

Mark McClardy,

Acting Manager, Airports Division, Western-Pacific Region, AWP–600.

[FR Doc. 03–14073 Filed 6–3–03; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Weight and Balance Control Program Committee; Correction

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of request for participation; correction.

SUMMARY: This document makes corrections to the notice of request of participation published in the **Federal Register** on May 28, 2003 (68 FR 31740), which announces the formation of the Weight and Balance Control Program Aviation Rulemaking Committee to conduct a review of AC 120–27C and other related guidance, and provide advice and recommendations.

FOR FURTHER INFORMATION CONTACT: Mr. Darcy Reed, 202–267–9948, or e-mail: *Darcy.D.Reed@faa.gov.*

Correction

In the notice FR Doc. 03–13243, published on May 28, 2003 (68 FR 31740), make the following correction:

On page 31741, in the first column, fourth full paragraph, line two, correct "docket number FAA–2003–XXXX" to read "docket number FAA–2003–15281."

Issued in Washington, DC on May 30, 2003.

Carol E. Giles,

Assistant Division Manager, Air Maintenance Division, Flight Standards Service.

[FR Doc. 03–14072 Filed 6–3–03; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

[Summary Notice No. PE–2003–34]

Petitions for Exemption; Summary of Petitions Received; Dispositions of Petitions Issued

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of petitions for exemption received and of dispositions of prior petitions.

SUMMARY: Pursuant to FAA's rulemaking provisions governing the application, processing, and disposition of petitions for exemption part 11 of Title 14, Code of Federal Regulations (14 CFR), this notice contains a summary of certain petitions seeking relief from specified requirements of 14 CFR, dispositions of certain petitions previously received, and corrections. The purpose of this notice is to improve the public's awareness of, and participation in, this aspect of FAA's regulatory activities. Neither publication of this notice nor the inclusion or omission of information in the summary is intended to affect the legal status of any petition or its final disposition.

DATES: Comments on petitions received must identify the petition docket number involved and must be received on or before June 24, 2003.

ADDRESSES: Send comments on any petition to the Docket Management System, U.S. Department of Transportation, Room Plaza 401, 400 Seventh Street, SW., Washington, DC 20590–0001. You must identify the docket number FAA–2003–XXXX at the beginning of your comments. If you wish to receive confirmation that FAA received your comments, include a self-addressed, stamped postcard.

You may also submit comments through the Internet to *http://dms.dot.gov.* You may review the public docket containing the petition, any comments received, and any final disposition in person in the Dockets Office between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. The Dockets Office (telephone 1–800–647–5527) is on the plaza level of the NASSIF Building at the compliance does not affect the applicability of any other certification requirements that fall outside the scope of this AC. Material in the AC is neither mandatory nor regulatory in nature and does not constitute a regulation.

DATES: Comments must be received on or before August 18, 2003.

ADDRESSES: Send all comments on the proposed AC to: Federal Aviation Administration, Small Airplane Directorate, Aircraft Certification Service, Regulations and Policy (ACE–111), 901 Locust Street, Kansas City, Missouri 64106.

FOR FURTHER INFORMATION CONTACT: Mr. Mark James, Standards Office, Small Airplane Directorate, Aircraft Certification Service, Kansas City, Missouri 64106, telephone (816) 329–4137, fax (816) 329–4090.

SUPPLEMENTARY INFORMATION: Any person may obtain a copy of this proposed AC by contacting the person named above under **FOR FURTHER INFORMATION CONTACT.** A copy of the AC will also be available on the Internet at *http://www.airweb.faa.gov/AC* within a few days.

Comments Invited

We invite interested parties to submit comments on the proposed AC. Commenters must identify AC 23–15A and submit comments to the address specified above. The FAA will consider all communications received on or before the closing date for comments before issuing the final AC. The proposed AC and comments received may be inspected at the Standards Office (ACE–110), 901 Locust, Room 301, Kansas City, Missouri, between the hours of 8:30 and 4 p.m. weekdays, except Federal holidays by making an appointment in advance with the person listed under **FOR FURTHER INFORMATION CONTACT.**

Background

AC 23–15A, Small Airplane Certification Compliance Program replacedAC 23–15, Small Airplane Certification Compliance Program, dated January 2, 1997.

Some industry and aviation organizations expressed concern that the typical means of compliance for some regulations might be more demanding than justified. As a consequence, industry, aviation groups, and the FAA formed a team to study this issue. Historical files, Designated Engineering Representatives (DER's), ACO's, and industry were used to determine target regulations and provide known means of compliance. This AC is a compilation of the study results, listing the regulations and attendant means of compliance that offer an improvement in certification efficiency. The listed means of compliance have been found acceptable and historically successful, but they are not the only methods that can be used to show compliance. In some cases, highly sophisticated airplanes may require more accurate or substantial solutions. Accordingly, the FAA is proposing and requesting comments on AC 23–15A.

Issued in Kansas City, Missouri on May 28, 2003.

James E. Jackson,

Acting Manager, Small Airplane Directorate, Aircraft Certification Office.

[FR Doc. 03–15139 Filed 6–18–03; 8:45 am]

BILLING CODE 4910–13–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Weight and Balance Control Program Committee; Correction

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of request for participation; correction.

SUMMARY: This document makes corrections to the notice of request of participation published in the **Federal Register** on May 28, 2003 (68 FR 31740), which announces the formation of the Weight and Balance Control Program Aviation Rulemaking Committee to conduct a review of AC 120–27C and other related guidance, and provide advice and recommendations.

FOR FURTHER INFORMATION CONTACT: Mr. Darcy Reed, 202–267–9948, or e-mail: *Darch.D.Reed@faa.gov.*

Correction

In the notice FR Doc. 03–13243, published on May 28, 2003 (68 FR 31740), make the following correction:

On page 31741, in the first column, first full paragraph, line one, correct "scheduled for June 24 and 25, 2003 in Washington, DC" to read "has been rescheduled; details on the meeting are available at *http://www.faa.gov/avr/afs/avgarc/.*"

Dated: Issued in Washington, DC on June 13, 2003.

David E. Cann,

Manager, Aircraft Maintenance Division, Flight Standards Service.

[FR Doc. 03–15527 Filed 6–18–03; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Highway Administration

Environmental Impact Statement: Anne Arundel County, MD and Prince George's County, MD

AGENCY: Federal Highway Administration.

ACTION: Notice of intent.

SUMMARY: The FHWA is issuing this notice to advise the public that an environmental impact statement will be prepared for a proposed highway project in Anne Arundel County and Prince George's County, Maryland.

FOR FURTHER INFORMATION CONTACT: Mr. Nelson J. Castellanos, Division Administrator, Federal Highway Administration, The Rotunda-Suite 220, 711 West 40th Street, Baltimore, Maryland 21211. Telephone (410) 962–4440.

SUPPLEMENTARY INFORMATION: The FHWA, in cooperation with the Maryland State Highway Administration, the Environmental Protection Agency and the U.S. Army Corps of Engineers, will prepare an environmental impact statement (EIS) on a proposal to improve transportation operations and mobility to MD 3 from north of US 50 to south of MD 32, in southwestern Anne Arundel County and northeastern Prince George's County. The proposed improvements will address existing and projected operational and safety issues for local traffic along MD 3 from north of US 50 to south of MD 32.

Congested traffic flow, inadequate intersections and crossings, increased residential and commercial development, and insufficient bicycle/pedestrian safety have accelerated the need for improvements to MD 3 within the study area. Several sections of roadway within the project limits are currently failing or experiencing failing conditions during the afternoon peak hours.

The alternates under consideration include (1) a no-build alternate; (2) a boulevard concept with interchange options; and (3) a modified boulevard concept with interchange options.

Coordination will continue with Federal, State, and local agencies, and with private organizations and citizens who have expressed interest. A Focus Group, comprised of local residents, community leaders, and business owners, meets periodically with the project engineers to assist in the development of the proposed alternates of improvements along MD 3, the interchanges and nearby intersections, subject to section 38 of the Arms Export Control Act would be in furtherance of the national security and foreign policy of the United States. Therefore, until further notice, the Department of State is hereby suspending all licenses and other approvals for: (a) Exports and other transfers of defense articles and defense services from the United States; (b) transfers of U.S.-origin defense articles and defense services from foreign destinations; and (c) temporary import of defense articles to or from the above-named entity.

Moreover, it is the policy of the United States to deny licenses and other approvals for exports and temporary imports of defense articles and defense services destined for this entity.

Dated: May 19, 2003.

John S. Wolf,

Assistant Secretary of State for Nonproliferation, Department of State.

[FR Doc. 03–13268 Filed 5–27–03; 8:45 am]

BILLING CODE 4710–25–P

DEPARTMENT OF STATE

[Public Notice 4374]

Bureau of Nonproliferation; Imposition of Missile Proliferation Sanctions Against Entities in Moldova

AGENCY: Department of State.

ACTION: Notice.

SUMMARY: A determination has been made that entities in Moldova have engaged in missile technology proliferation activities that require imposition of sanctions pursuant to the Arms Export Control Act, as amended, and the Export Administration Act of 1979, as amended (as carried out under Executive Order 13222 of August 17, 2001).

EFFECTIVE DATE: May 9, 2003.

FOR FURTHER INFORMATION CONTACT: Vann H. Van Diepen, Office of Chemical, Biological and Missile Nonproliferation, Bureau of Nonproliferation, Department of State (202–647–1142).

SUPPLEMENTARY INFORMATION: Pursuant to section 73(a)(1) of the Arms Export Control Act (22 U.S.C. 2797b(a)(1)); Section 11B(b)(1) of the Export Administration Act of 1979 (50 U.S.C. app. 2410b(b)(1)), as carried out under Executive Order 13222 of August 17, 2001 (hereinafter cited as the "Export Administration Act of 1979"); and Executive Order 12851 of June 11, 1993; a determination was made on May 9, 2003, that the following foreign persons have engaged in missile technology proliferation activities that require the imposition of the sanctions described in section 73(a)(2)(A) of the Arms Export Control Act (22 U.S.C. 2797b(a)(2)(A)) and section 11B(b)(1)(B)(i) of the Export Administration Act of 1979 (50 U.S.C. app. 2410b(b)(1)(B)(i)) on the following entities:

1. Mikhail Pavlovich Vladov (Moldovan person).
2. Cuanta S.A. (Moldova) and its sub-units and successors.
3. Computer & Communicatii SRL (Moldova) and its sub-units and successors.

Accordingly, the following sanctions are being imposed on these entities:

(A) New individual licenses for exports to the entities described above of MTCR Annex equipment or technology controlled pursuant to the Export Administration Act of 1979 will be denied for two years;

(B) New licenses for export to the entities described above of MTCR Annex equipment or technology controlled pursuant to the Arms Export Control Act will be denied for two years; and

(C) No new United States Government contracts relating to MTCR Annex equipment or technology involving the entities described above will be entered into for two years.

With respect to items controlled pursuant to the Export Administration Act of 1979, the export sanction only applies to exports made pursuant to individual export licenses.

These measures shall be implemented by the responsible departments and agencies of the United States Government as provided in Executive Order 12851 of June 11, 1993.

Dated: May 19, 2003.

John S. Wolf,

Assistant Secretary of State for Nonproliferation, Department of State.

[FR Doc. 03–13151 Filed 5–27–03; 8:45 am]

BILLING CODE 4710–25–P

DEPARTMENT OF TRANSPORTATION

Office of the Secretary

Aviation Proceedings, Agreements Filed the Week Ending May 16, 2003

The following agreements were filed with the Department of Transportation under the provisions of 49 U.S.C. 412 and 414. Answers may be filed within 21 days after the filing of the application.

Docket Number: OST–2003–15173.

Date Filed: May 13, 2003.

Parties: Members of the International Air Transport Association.

Subject: Mail Vote 300—Resolution 010o, PTC2 ME 0121 dated 16 May 2003, PTC2 EUR–ME 0161 dated 16 May 2003, PTC2 ME–AFR 0106 dated 16 May 2003, PTC23 ME–TC3 0176 dated 16 May 2003, Special Passenger Amending Resolution from Qatar r1–r7, Intended effective date: 22 May 2003.

Dorothy Y. Beard,

Chief, Docket Operations & Media Management, Federal Register Liaison.

[FR Doc. 03–13239 Filed 5–27–03; 8:45 am]

BILLING CODE 4910–62–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Weight and Balance Control Program Committee

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of request for participation on industry advisory committee (IAC) formation.

SUMMARY: By this notice, the FAA announces the formation of an advisory committee to conduct a comprehensive review and rewrite of Advisory Circular (AC) 120–27C, Aircraft Weight and Balance Control, and other related guidance. The FAA will establish a Weight and Balance Control Program Aviation Rulemaking Committee (ARC) to conduct this review and provide advice and recommendations.

The FAA invites individuals interested in serving on this committee and/or associated work groups to request membership in accordance with this notice. The FAA will select members to provide a balance of viewpoints, interests, and expertise. Membership on the committee may be limited to facilitate discussions and to maintain a balance of interests.

In addition, the FAA invites interested individuals to submit specific, detailed written comments, or provide input on the affected advisory and guidance documents. These comments will be considered in the committee discussions and will assist in determining a method of compliance with regard to the weight and balance control program.

DATES: *Membership:* Individuals interested in participating on the committee or work group should submit a request on or before June 6, 2003. The FAA will notify all selected members and participants in writing in advance of the first meeting. Your request should provide the following information:

—Contact information (name, company and position, address, phone, facsimile, and e-mail)
—Segment(s) of the industry or organization/association you represent
—Experience, subject expertise, or other background information

The first meeting of the Weight and Balance Control Program ARC is scheduled for June 24 and 25, 2003 in Washington, DC. The committee will report its recommendations to the Associate Administrator for Regulation and Certification through the Director, flight Standards, no later than 6 months from the date of the first meeting. Work groups will be scheduled as determined by the steering committee and work group members to provide information and meet schedule requirements.

Comments: The FAA will consider all comments on this advisory and regulatory review filed on or before June 24, 2003. The FAA will consider comments filed later if it is possible to do so without incurring expense or delay.

ADDRESSES: *Membership:* Individuals requesting membership or participation on the Weight and Balance Control Program ARC and/or work groups should contact Darcy Reed, AFS–330, 800 Independence Ave., SW., Washington, DC 20591, telephone at (202) 267–9948, facsimile at (202) 267–5115, or by e-mail: *Darcy.D.Reed@FAA.GOV*, or contact Dennis Pratte, AFS–220, 800 Independence Ave., SW., Washington, DC, 20591, telephone at (202) 267–5488, facsimile at (202) 267–5229, or by e-mail: *Dennis.Pratte@FAA.GOV*.

Comments: Address your comments to the Docket Management System, U.S. Department of Transportation, Room Plaza 401, 400 Seventh Street, SW., Washington, DC 20590–001. You must identify docket number FAA–2003–XXXXX at the beginning of your comments, and you should submit two copies of your comments. If you wish to receive confirmation that the FAA received your comments, include a self-addressed, stamped postcard on which the docket number appears. We will stamp the date on the postcard and mail it to you.

You may also submit and/or review comments about this public docket through the Internet at *http://dms.dot.gov/*. You may review the public docket containing comments to this proposed guidance in person in the Dockets Office between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. the Dockets Office is on the plaza level of the NASSIF Building at the Department of Transportation at the above address.

FOR FURTHER INFORMATION CONTACT: Darcy Reed, AFS–330, or Dennis Pratte, AFS–220, at the address above.

SUPPLEMENTARY INFORMATION: Additional information on the committee membership, dates , and other information may be obtained on the Flight Standards Web site under the heading "Weight and Balance Control Program Aviation Rulemaking Committee" at: *http://www.faa.gov/avr/afs/AvgARC/*.

Issued in Washington, DC on May 21, 2003.

David E. Cann,

Air Maintenance Division, Flight Standards Service.

[FR Doc. 03–13243 Filed 5–27–03; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aging Transport Systems Rulemaking Advisory Committee

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of new tasks for the Aging Transport Systems Rulemaking Advisory Committee (ATSRAC).

SUMMARY: This notice announces the new tasks assigned to and accepted by the ATSRAC.

FOR FURTHER INFORMATION CONTACT: Charles Huber, Manager, Safety Management Branch, ANM—117, Executive Director of ATSRAC, Federal Aviation Administration, 1601 Lind Avenue, SW., Renton, WA 98055; telephone (425) 227–2589; fax (425) 227–1320.

SUPPLEMENTARY INFORMATION:

Background

In response to the White House Commission on Aviation Safety and Security, the FAA formed the Aging Non-Structural Systems Study Team, to develop the FAA's approach to improving management of aging wire systems. To help fulfill the actions specified in the Aging Non-Structural Systems Plan, the FAA set up an Aging Transport Systems Rulemaking Advisory Committee (ATSRAC) to give recommendations on airplane system safety issues.

In 1998, the FAA assigned five tasks to the ATSRAC. These tasks included collecting data on aging wiring systems through airplane inspections, reviewing airplane manufacturers' service information, reviewing operators' maintenance programs, and providing the FAA with recommendations to enhance the safety of those systems. The FAA held a public meeting on January 20, 1999, to discuss the Committee's operations and their assigned tasks.

The ATSRAC found that problems associated with systems on aging airplanes are not entirely related to the degradation overtime of wire systems. The review of these systems also found inadequate installation and maintenance practices could lead to what is commonly referred to as an "aging system" problem. Therefore, the scope of the ATSRAC's work includes, not only age-related issues, but also involves improving the continued airworthiness of airplane systems (*i.e.*, wire systems).

The FAA accepted the ATSRAC recommendations from the first five tasks and subsequently assigned five additional tasks to get the Committee's help in implementing the safety enhancements from their earlier recommendations. The FAA is now considering the ATSRAC recommendations on the second set of tasks. These recommendations include rulemaking and other actions. Implementation of the ATSRAC recommendations is a major part of the FAA's Enhanced Airworthiness Program for Airplane Systems (EAPAS), a program that addresses the safety of wiring systems.

The FAA recognizes the knowledge and experience the ATSRAC provides. Because ATSRAC members represent a large cross-section of industry, they will supply the FAA with an invaluable resource of technical expertise in a variety of areas. Therefore, the FAA has assigned three new tasks to the ATSRAC to help carry out the EAPAS objectives.

This notice announces the new tasks, which the ATSRAC has accepted. These tasks will allow the FAA to get the Committee's continuing help to carry out their recommendations. ATSRAC has chosen to form harmonization working groups (HWG) to provide technical support to develop their recommendations on these tasks. A discussion of the new tasks and harmonization working groups (HWG) follows.

I. EAPAS Rulemaking Advisory HWG

To promote efficient rulemaking and compliance with this rulemaking, the FAA tasks ATSRAC to provide, when specifically sought by the FAA, recommendations about the issues discussed in items I–1 through I–3 of this section. The ATSRAC Executive Director will send each FAA task to the ATSRAC Chair to obtain the ATSRAC subject to section 38 of the Arms Export Control Act would be in furtherance of the national security and foreign policy of the United States. Therefore, until further notice, the Department of State is hereby suspending all licenses and other approvals for: (a) Exports and other transfers of defense articles and defense services from the United States; (b) transfers of U.S.-origin defense articles and defense services from foreign destinations; and (c) temporary import of defense articles to or from the above-named entity.

Moreover, it is the policy of the United States to deny licenses and other approvals for exports and temporary imports of defense articles and defense services destined for this entity.

Dated: May 19, 2003.

John S. Wolf,

Assistant Secretary of State for Nonproliferation, Department of State.

[FR Doc. 03–13268 Filed 5–27–03; 8:45 am]

BILLING CODE 4710–25–P

DEPARTMENT OF STATE

[Public Notice 4374]

Bureau of Nonproliferation; Imposition of Missile Proliferation Sanctions Against Entities in Moldova

AGENCY: Department of State.

ACTION: Notice.

SUMMARY: A determination has been made that entities in Moldova have engaged in missile technology proliferation activities that require imposition of sanctions pursuant to the Arms Export Control Act, as amended, and the Export Administration Act of 1979, as amended (as carried out under Executive Order 13222 of August 17, 2001).

EFFECTIVE DATE: May 9, 2003.

FOR FURTHER INFORMATION CONTACT: Vann H. Van Diepen, Office of Chemical, Biological and Missile Nonproliferation, Bureau of Nonproliferation, Department of State (202–647–1142).

SUPPLEMENTARY INFORMATION: Pursuant to section 73(a)(1) of the Arms Export Control Act (22 U.S.C. 2797b(a)(1)); Section 11B(b)(1) of the Export Administration Act of 1979 (50 U.S.C. app. 2410b(b)(1)), as carried out under Executive Order 13222 of August 17, 2001 (hereinafter cited as the "Export Administration Act of 1979"); and Executive Order 12851 of June 11, 1993; a determination was made on May 9, 2003, that the following foreign persons have engaged in missile technology proliferation activities that require the imposition of the sanctions described in section 73(a)(2)(A) of the Arms Export Control Act (22 U.S.C. 2797b(a)(2)(A)) and section 11B(b)(1)(B)(i) of the Export Administration Act of 1979 (50 U.S.C. app. 2410b(b)(1)(B)(i)) on the following entities:

1. Mikhail Pavlovich Vladov (Moldovan person).
2. Cuanta S.A. (Moldova) and its sub-units and successors.
3. Computer & Communicatii SRL (Moldova) and its sub-units and successors.

Accordingly, the following sanctions are being imposed on these entities:

(A) New individual licenses for exports to the entities described above of MTCR Annex equipment or technology controlled pursuant to the Export Administration Act of 1979 will be denied for two years;

(B) New licenses for export to the entities described above of MTCR Annex equipment or technology controlled pursuant to the Arms Export Control Act will be denied for two years; and

(C) No new United States Government contracts relating to MTCR Annex equipment or technology involving the entities described above will be entered into for two years.

With respect to items controlled pursuant to the Export Administration Act of 1979, the export sanction only applies to exports made pursuant to individual export licenses.

These measures shall be implemented by the responsible departments and agencies of the United States Government as provided in Executive Order 12851 of June 11, 1993.

Dated: May 19, 2003.

John S. Wolf,

Assistant Secretary of State for Nonproliferation, Department of State.

[FR Doc. 03–13151 Filed 5–27–03; 8:45 am]

BILLING CODE 4710–25–P

DEPARTMENT OF TRANSPORTATION

Office of the Secretary

Aviation Proceedings, Agreements Filed the Week Ending May 16, 2003

The following agreements were filed with the Department of Transportation under the provisions of 49 U.S.C. 412 and 414. Answers may be filed within 21 days after the filing of the application.

Docket Number: OST–2003–15173.

Date Filed: May 13, 2003.

Parties: Members of the International Air Transport Association.

Subject: Mail Vote 300—Resolution 010o, PTC2 ME 0121 dated 16 May 2003, PTC2 EUR–ME 0161 dated 16 May 2003, PTC2 ME–AFR 0106 dated 16 May 2003, PTC23 ME–TC3 0176 dated 16 May 2003, Special Passenger Amending Resolution from Qatar r1–r7, Intended effective date: 22 May 2003.

Dorothy Y. Beard,

Chief, Docket Operations & Media Management, Federal Register Liaison.

[FR Doc. 03–13239 Filed 5–27–03; 8:45 am]

BILLING CODE 4910–62–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Weight and Balance Control Program Committee

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of request for participation on industry advisory committee (IAC) formation.

SUMMARY: By this notice, the FAA announces the formation of an advisory committee to conduct a comprehensive review and rewrite of Advisory Circular (AC) 120–27C, Aircraft Weight and Balance Control, and other related guidance. The FAA will establish a Weight and Balance Control Program Aviation Rulemaking Committee (ARC) to conduct this review and provide advice and recommendations.

The FAA invites individuals interested in serving on this committee and/or associated work groups to request membership in accordance with this notice. The FAA will select members to provide a balance of viewpoints, interests, and expertise. Membership on the committee may be limited to facilitate discussions and to maintain a balance of interests.

In addition, the FAA invites interested individuals to submit specific, detailed written comments, or provide input on the affected advisory and guidance documents. These comments will be considered in the committee discussions and will assist in determining a method of compliance with regard to the weight and balance control program.

DATES: *Membership:* Individuals interested in participating on the committee or work group should submit a request on or before June 6, 2003. The FAA will notify all selected members and participants in writing in advance of the first meeting. Your request should provide the following information:

—Contact information (name, company and position, address, phone, facsimile, and e-mail)
—Segment(s) of the industry or organization/association you represent
—Experience, subject expertise, or other background information

The first meeting of the Weight and Balance Control Program ARC is scheduled for June 24 and 25, 2003 in Washington, DC. The committee will report its recommendations to the Associate Administrator for Regulation and Certification through the Director, flight Standards, no later than 6 months from the date of the first meeting. Work groups will be scheduled as determined by the steering committee and work group members to provide information and meet schedule requirements.

Comments: The FAA will consider all comments on this advisory and regulatory review filed on or before June 24, 2003. The FAA will consider comments filed later if it is possible to do so without incurring expense or delay.

ADDRESSES: *Membership:* Individuals requesting membership or participation on the Weight and Balance Control Program ARC and/or work groups should contact Darcy Reed, AFS–330, 800 Independence Ave., SW., Washington, DC 20591, telephone at (202) 267–9948, facsimile at (202) 267–5115, or by e-mail: *Darcy.D.Reed@FAA.GOV*, or contact Dennis Pratte, AFS–220, 800 Independence Ave., SW., Washington, DC, 20591, telephone at (202) 267–5488, facsimile at (202) 267–5229, or by e-mail: *Dennis.Pratte@FAA.GOV*.

Comments: Address your comments to the Docket Management System, U.S. Department of Transportation, Room Plaza 401, 400 Seventh Street, SW., Washington, DC 20590–001. You must identify docket number FAA–2003–XXXXX at the beginning of your comments, and you should submit two copies of your comments. If you wish to receive confirmation that the FAA received your comments, include a self-addressed, stamped postcard on which the docket number appears. We will stamp the date on the postcard and mail it to you.

You may also submit and/or review comments about this public docket through the Internet at *http://dms.dot.gov/*. You may review the public docket containing comments to this proposed guidance in person in the Dockets Office between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. the Dockets Office is on the plaza level of the NASSIF Building at the Department of Transportation at the above address.

FOR FURTHER INFORMATION CONTACT: Darcy Reed, AFS–330, or Dennis Pratte, AFS–220, at the address above.

SUPPLEMENTARY INFORMATION: Additional information on the committee membership, dates , and other information may be obtained on the Flight Standards Web site under the heading "Weight and Balance Control Program Aviation Rulemaking Committee" at: *http://www.faa.gov/avr/afs/AvgARC/*.

Issued in Washington, DC on May 21, 2003.

David E. Cann,

Air Maintenance Division, Flight Standards Service.

[FR Doc. 03–13243 Filed 5–27–03; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aging Transport Systems Rulemaking Advisory Committee

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of new tasks for the Aging Transport Systems Rulemaking Advisory Committee (ATSRAC).

SUMMARY: This notice announces the new tasks assigned to and accepted by the ATSRAC.

FOR FURTHER INFORMATION CONTACT: Charles Huber, Manager, Safety Management Branch, ANM—117, Executive Director of ATSRAC, Federal Aviation Administration, 1601 Lind Avenue, SW., Renton, WA 98055; telephone (425) 227–2589; fax (425) 227–1320.

SUPPLEMENTARY INFORMATION:

Background

In response to the White House Commission on Aviation Safety and Security, the FAA formed the Aging Non-Structural Systems Study Team, to develop the FAA's approach to improving management of aging wire systems. To help fulfill the actions specified in the Aging Non-Structural Systems Plan, the FAA set up an Aging Transport Systems Rulemaking Advisory Committee (ATSRAC) to give recommendations on airplane system safety issues.

In 1998, the FAA assigned five tasks to the ATSRAC. These tasks included collecting data on aging wiring systems through airplane inspections, reviewing airplane manufacturers' service information, reviewing operators' maintenance programs, and providing the FAA with recommendations to enhance the safety of those systems. The FAA held a public meeting on January 20, 1999, to discuss the Committee's operations and their assigned tasks.

The ATSRAC found that problems associated with systems on aging airplanes are not entirely related to the degradation overtime of wire systems. The review of these systems also found inadequate installation and maintenance practices could lead to what is commonly referred to as an "aging system" problem. Therefore, the scope of the ATSRAC's work includes, not only age-related issues, but also involves improving the continued airworthiness of airplane systems (*i.e.*, wire systems).

The FAA accepted the ATSRAC recommendations from the first five tasks and subsequently assigned five additional tasks to get the Committee's help in implementing the safety enhancements from their earlier recommendations. The FAA is now considering the ATSRAC recommendations on the second set of tasks. These recommendations include rulemaking and other actions. Implementation of the ATSRAC recommendations is a major part of the FAA's Enhanced Airworthiness Program for Airplane Systems (EAPAS), a program that addresses the safety of wiring systems.

The FAA recognizes the knowledge and experience the ATSRAC provides. Because ATSRAC members represent a large cross-section of industry, they will supply the FAA with an invaluable resource of technical expertise in a variety of areas. Therefore, the FAA has assigned three new tasks to the ATSRAC to help carry out the EAPAS objectives.

This notice announces the new tasks, which the ATSRAC has accepted. These tasks will allow the FAA to get the Committee's continuing help to carry out their recommendations. ATSRAC has chosen to form harmonization working groups (HWG) to provide technical support to develop their recommendations on these tasks. A discussion of the new tasks and harmonization working groups (HWG) follows.

I. EAPAS Rulemaking Advisory HWG

To promote efficient rulemaking and compliance with this rulemaking, the FAA tasks ATSRAC to provide, when specifically sought by the FAA, recommendations about the issues discussed in items I–1 through I–3 of this section. The ATSRAC Executive Director will send each FAA task to the ATSRAC Chair to obtain the ATSRAC

DRAFT

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

DRAFT

AC No. 120–27D version 6.0

AIRCRAFT WEIGHT AND BALANCE CONTROL

DRAFT
March 15, 2004

CONTENTS[DRP1]

Page No.

APPENDIXES

CHAPTER 1. INTRODUCTION

1. PURPOSE OF THIS AC.

a. This advisory circular (AC) provides one means, but not the only means, for obtaining the approval of a weight and balance control system for multi-engine turbine aircraft certificated under part 25 or 29 of Title 14, Code of Federal Regulations (14 CFR), as applicable, and operated under 14 CFR parts 91 subpart K, 121, ~~125,~~ or 135.

b. The intent of this AC is to provide methods and procedures for developing a weight and balance control system and includes guidance for using average and estimated weights in accordance with 121.153(b) and other applicable parts of 14 CFR parts 91 subpart K, 121, ~~125,~~ and 135.

c. Actual weights must be used for computing an aircraft weight and balance when operating an aircraft certificated under a part other than commuter category, part 25, or part 29, unless such aircraft has equivalent approved commuter category, part 25, or part 29 performance data. Actual weights must also be used for the following aircraft:

1. Reciprocating powered aircraft, and
2. Single-engine turbine powered aircraft (with the exception of EMS helicopter operations), and
3. Aircraft type certificated with less than 5 passenger seats.

2. FOCUS. This document provides guidance to operators that are either required to have an approved weight and balance program under part 121, or choose to use average aircraft, passenger or baggage weights when operating under parts 91 subpart K, ~~125,~~ or 135.

3. CANCELLATION. AC 120–27C, Aircraft Weight and Balance Control, dated November 7, 1995, HBAW 95–14 and HBAT 95–15, dated November 17, 1995, Adherence to Advisory Circular 120–27C "Aircraft Weight and Balance Control", are cancelled.

4. DISCUSSION.

a. Accurate calculation of an aircraft's weight and center of gravity prior to flight is fundamental to compliance with the limits established for the aircraft. These limits are contained in the Airplane Flight Manual, and include the Certificated Weight Limits, the Center of Gravity Envelope, and Performance Limits. The take-off weight is usually calculated by adding the empty weight of the aircraft, payload (passengers and cargo), and fuel. It is recognized that the determination of the actual takeoff weight will never be exact, and the methods and procedures contained herein represent accepted industry best practices. Furthermore, the objective is to calculate the ACTUAL take-off weight and center of gravity, without any "pad" or conservatism in the weights. This is contrasted with the limit weights, which do contain a certain amount of conservatism required by regulations and the certification process.

b. For many years, international best practice has allowed the use of average passenger and bag weights to calculate the aircraft's weight and balance on transport category aircraft. This eliminates many potential sources of error associated with accumulating and adding large numbers of relatively small weights. Differences between the actual passenger and bag weights and the calculated weights can occur when using average weights. For statistical reasons these errors become more significant in terms of their effect on aircraft performance as the size of the aircraft (and therefore seating capacity) reduces. The certification basis of the aircraft also affects how much conservatism is in the performance limits, and therefore how much error in the actual weight calculation can be tolerated.

c. The use of average passenger and bag weights requires vigilance on the part of both the operator and the FAA. The FAA will update the guidance in this AC as the average body weight of the traveling public changes, or if the regulatory requirements for carry-on bags or personal items change. The operator is ultimately responsible for determining that the use of the standard average weights presented in this AC is appropriate for their operation.

CHAPTER 2. TERMS, DEFINITIONS, AND GENERAL STANDARDS

1. DEFINITIONS.

a. Basic Empty Weight. Standard basic empty weight plus or minus weight of standard item variations.

b. Cargo. As used in this AC, cargo refers to everything carried in the cargo compartments of the aircraft. This includes baggage, mail, freight, express, and company materials. It also includes live animals, dangerous goods, and hazardous materials as subcategories of the above.

c. Carry-On Bag. A bag that the operator allows the passenger to carry onboard. It must be of a size and shape that will allow it to be stowed under the passenger seat or in an overhead bin. The exact dimensional limits are established by the operator based on the particular aircraft stowage limits, but typically carry-on bags are no more than about 45 inches for the sum of length, width, and height.

d. Certificated Weight Limits. Weight and CG limits are established at the time of aircraft certification. They are specified in the applicable Airplane Flight Manual (AFM). The following are general definitions of certificated weight limits normally considered in weight and balance programs.

(1) Maximum Zero Fuel Weight. The maximum permissible weight of an aircraft with no disposable fuel and oil.

(2) Maximum Landing Weight. The maximum weight at which the aircraft may normally be landed.

(3) Maximum Takeoff Weight. The maximum allowable aircraft weight at the start of the takeoff run.

(4) Maximum Taxi Weight. The maximum allowable aircraft weight for taxi.

e. Checked Bags. Checked bags are those bags placed in the cargo compartment of the aircraft. This includes bags that are too large to be placed in the cabin of the aircraft or those bags that are required to be carried in the cargo compartment either by regulation, security program, or company policy. For bags checked plane-side, see Plane-Side Loaded Bags.

f. Fleet Empty Weight. Average basic empty weight used for a fleet or group of aircraft of the same model and configuration. The definition of a group within the context of Fleet Empty Weight is separate and distinct from the definitions under Grouping of Aircraft.

g. Freight. Cargo carried for hire in the cargo compartment that is not mail or passenger bags.

h. Grouping of Aircraft: For the purposes of this AC, aircraft are divided into three distinct groups:

Large Cabin Aircraft: Aircraft with a maximum type certificated seating capacity of 71 or more passenger seats.
Medium Cabin Aircraft: Aircraft with a maximum type certificated seating capacity of less than 71 passenger seats but 30 or more passenger seats.
Small Cabin Aircraft: Aircraft with a maximum type certificated seating capacity of less than 30 passenger seats but more than 4 passenger seats.

i. Heavy bags. For the purpose of this AC, heavy bags are considered any bag that weighs in excess of 50 lb but less than 100 lb. Bags that are 100 lbs or more are considered freight.

j. Manufacturer's Empty Weight. Weight of structure, powerplant, furnishings, systems, and other items of equipment that are an integral part of a particular aircraft configuration. (It is essentially a "dry" weight, including only those fluids contained in closed systems.)

k. Non-luggage bags. Items accepted as checked bags that do not meet the normal criteria for luggage. Examples of non-luggage bags include: golf bags, fishing equipment packages, wheelchairs, and strollers in the shipping configuration, windsurfing kits, boxed bicycles, etc.

l. Operational Empty Weight. Basic empty weight or fleet empty weight plus operational items.

m. Operational Items. Personnel, equipment, and supplies necessary for a particular operation but not included in basic empty weight. These items may vary for a particular aircraft and may include, but are not limited to, the following:

(1) Crew, supernumeraries, and baggage.

(2) Manuals and navigation equipment.

(3) Passenger service equipment, including pillows, blankets, magazines, etc.

(4) Removable service equipment for cabin, galley, and bar.

(5) Food and beverage, including liquor.

(6) Usable fluids, other than those in useful load.

(7) Required emergency equipment for all flights.

(8) Life rafts, life vests, and emergency transmitters.

(9) Aircraft unit load devices.

(10) Potable water, etc.

(11) Drainable unusable fuel.

(12) Spare parts normally carried on-board and not accounted for as cargo.

(13) All other items of equipment considered standard by the operator.

n. Passenger Assist/Comfort Animals and Devices. These include, but are not limited to, canes, crutches, walkers, wheelchairs, medically required animal comfort companions, or animals required to assist the vision impaired. These are included in the personal items that an operator allows a passenger to carry onboard.

o. Passenger Weight. Passenger weight is either the actual weighed, or approved average weight of the passenger. An adult is defined as an individual thirteen years or older. A child is defined as an individual ages 2 through 12 (an individual that has reached their second birthday, but not yet reached their thirteenth birthday. Infants are children that have not yet reached their second birthday and are considered part of the adult passenger weight.

p. Personal Item. Items the operator may allow a passenger to carry on board, in addition to a carry-on bag. Typically, an operator may allow one personal item such as a purse, briefcase, computer and case, camera and case, diaper bag, or an item of similar size. Other items, such as coats, umbrellas, reading material, food for immediate consumption, infant seats, and "passenger assist/comfort animals and devices", are allowed to be carried on the aircraft and not counted against the personal item allowance.

q. Plane-Side Loaded Bag. Any bag or item that is placed at the door or steps of an aircraft and subsequently placed in the aircraft cargo compartment or cargo bin.

r. Standard Basic Empty Weight. Manufacturer's empty weight plus standard items.

s. Standard Items. Equipment and fluids not considered an integral part of a particular aircraft and not a variation for the same type of aircraft. These items may include, but are not limited to, the following:

(1) Unusable fuel and other unusable fluids.

(2) Engine oil.

(3) Toilet fluid and chemical.

(4) Fire extinguishers, pyrotechnics, and emergency oxygen equipment.

(5) Structure in galley, buffet, and bar.

(6) Supplementary electronic equipment.

CHAPTER 3. AIRCRAFT EMPTY WEIGHT

1. ESTABLISHING INITIAL WEIGHT. Prior to being placed into service, each aircraft should be weighed and the empty weight and CG location established. New aircraft are normally weighed at the factory and are eligible to be placed into operation without reweighing if the weight and balance records have been adjusted for alterations or modifications to the aircraft. Aircraft transferred from one operator, that has an approved weight and balance program, to another operator with an approved program need not be weighed prior to use by the receiving operator unless more than 36 calendar months have elapsed since last individual or fleet weighing. Aircraft transferred, purchased or leased from an operator without an approved weight and balance program can be placed into service without being reweighed if the last weighing was accomplished by an acceptable method within the last 12 calendar months.

2. WEIGHT AND BALANCE CHANGE RECORD. The weight and balance system should include methods, such a log or ledger, by which the operator will maintain a complete, current, and continuous record of the weight and CG of each aircraft. Alterations and changes affecting either the weight and/or balance of the aircraft should be recorded in this log. An operator should record in this log all weight changes that are greater than a minimum reportable increment added to, removed from, or relocated on an aircraft. The minimum reportable increment is 10 lb for a large cabin aircraft, 5 lb for a medium cabin aircraft, and 1 lb for a small cabin aircraft. All other weight changes are considered negligible and not subject to being logged.

3. Operational Empty Weight. The loading schedule may utilize the individual weight of the aircraft in computing operational weight and balance, or the operator may choose to establish fleet empty weights for a fleet or group of aircraft.

a. Establishment of OEW. The Operational Empty Weight and CG position of each aircraft should be reestablished at the specified reweighing periods. In addition, it should be reestablished whenever the cumulative change to the Weight and Balance Log exceeds plus or minus one-half of 1 percent of the maximum landing weight, or whenever the cumulative change in the CG position exceeds one-half of 1 percent of the mean aerodynamic chord (MAC). In the case of helicopters, whenever the cumulative change in the CG position exceeds one-half of 1 percent of the total CG range, the weight and balance should be reestablished.

b. Fleet Operating Empty Weights. An operator my choose to utilize one weight for a fleet or group of aircraft if the weight and center of gravity of each aircraft is within the limits stated above for Establishment of OEW. When the cumulative changes to an aircraft Weight and Balance Log exceed the weight or cg limits for the established fleet weight, the empty weight for that aircraft should be reestablished. This may be done by moving the aircraft to another group, or reestablishing new Fleet Operational Empty Weights.

4. Periodic Weighing. Aircraft are normally weighed at intervals of 36 calendar months. An operator may, however, extend this weighing period for a particular model aircraft when pertinent records of actual routine weighing during the preceding period of operation show that weight and balance records maintained are sufficiently accurate to indicate aircraft weights and CG positions are within the cumulative limits specified for establishment of OEW, above. Such applications should be substantiated in each instance with at least two aircraft weighed. An increase should not be granted which would permit any aircraft to exceed 48 calendar months since the last weighing. In the case of helicopters, increases should not exceed a time that is equivalent to the aircraft overhaul period.

a. Fleet Weighings. An operator may choose to weigh only a portion of the fleet and apply the unaccounted weight and moment change determined by this sample to the remainder of the fleet.

(1) A fleet is composed of a number of aircraft of the same model (For example, B747-200s in a passenger configuration and B747-200 freighters should be different fleets. Likewise, B757-200s and B757-300s should be different fleets). The primary purpose of defining a fleet is to determine how many aircraft should be weighed in each weighing cycle. A fleet may be further divided into groups to establish Fleet Operating Empty Weights.

(2) The number of aircraft weighed in each period may be determined by the following schedule:

(i) For a fleet of 1 to 3, weigh all aircraft;

(ii) For a fleet of 4 to 9, weigh 3 aircraft plus at least 50 percent of the number over 3;

(iii) For fleets over 9, weigh 6 aircraft plus at least 10 percent of the number over 9.

(3) In choosing the aircraft to be weighed, the aircraft in the fleet having the highest time since last weighing should be selected.

(4) An operator should establish a time limit such that all aircraft in a fleet are eventually weighed. Based on the length of time that a fleet of aircraft typically remains in service with an operator, the time limit should not exceed 18 years (six 3-year weighing cycles). It is not intended that an operator be required to weigh any remaining aircraft in the event that business conditions result in retirement of a fleet before all aircraft have been weighed.

b. Weighing Aircraft – Major Modifications. For most aircraft modifications, computing the weight and balance changes is practical. For large or extensive modifications (usually interior reconfigurations) the large number of parts removed, replaced, and installed make an accurate determination of the weight and balance change by computation impractical. In those cases, it is desirable to weigh the aircraft to confirm the net weight and balance change estimate. In this case the operator should weigh two or more aircraft as required to get consistent results. The operator may choose to weigh the aircraft before and after the modification, or just after the modification.

c. Aircraft Weight Establishment – Weighing Procedure. Normal precautions, consistent with good practices, should be taken such as checking to insure the aircraft has the required items of installed equipment and accounting for fluids on the aircraft.. Weighing should be accomplished in an enclosed building. Scale readings will stabilize faster if there are no drafts, e.g., doors closed and heating and air conditioning ventilation off. Scale accuracy should be categorized as follows:

(1) For aircraft less than 30,000 lb empty weight, the weighing equipment should be accurate within ±0.1 percent of reading or 3 lb, whichever is greater, with weights displayed in a minimum of 1 lb graduations.

(2) For aircraft greater than 30,000 lb empty weight, the weighing equipment should be accurate within ± 0.1 percent.

(3) Scales must be used in accordance with the manufacturer's instructions, and should be calibrated, certified and traceable by either the manufacturer or by a certified laboratory, such as a civil department of weights and measures, periodically as recommended in the manufacturer's calibration schedule.

CHAPTER 4. AIRCRAFT LOADING SYSTEM

1. LOADING SCHEDULE.

a. The loading schedule is used to document compliance with the certificated weight and balance limitations contained in the manufacturer's AFM and Weight and Balance Manual (WBM).

b. The loading schedule is developed by the operator, based on its specific loading calculation procedures, and provides the operational limits for use with the operator's weight and balance program approved under this AC. These approved operational limits are more restrictive than the manufacturer's certificated limits. This is because the loading schedule is generally designed to check only specific conditions (e.g., takeoff and zero fuel) known prior to takeoff, and must account for variations in weight and balance in flight. It also must account for factors chosen to be excluded, for ease of use, from the calculation process. Loading the aircraft so that the calculated weight and balance is within the approved limits will maintain the actual weight and balance within the certificated limits throughout the flight.

c. Development of a loading schedule represents a trade-off between ease of use and loading flexibility. A schedule can provide more loading flexibility by requiring more detailed inputs, or it can be made easier to use by further limiting the operational limits to account for the uncertainty caused by the less detailed inputs.

d. Several types of loading schedules are commonly used - computer programs, as well as "paper" schedules, which can be either graphical, such as an alignment ("chase around chart") system or slide rule, or numerical, such as an adjusted weight or index system.

e. It is often more convenient to compute the balance effects of combined loads and to display the results by using "balance units" or "index units." This is done by adding the respective moments (weight times arm) of each item. Graphing the moments results in a "fan grid" where lines of constant balance arms (BA) or %MAC are closer together at lower weights and further apart at higher weights. Direct graphical or numerical addition of the balance effects are possible using these moment values.

f. To make the magnitude of the numbers more manageable, moments can be converted to an index unit. For example:

$$index\_unit = \frac{weight \times (BA - datum)}{M} + K ,$$

Where ***datum*** is the reference BA that will plot as a vertical line on the fan grid, ***M*** and ***K*** are constants that are selected by the operator. ***M*** is used to scale the index values, and ***K*** is used to set the index value of the reference balance arm.

2. ONBOARD WEIGHT AND BALANCE SYSTEMS (OBWBS)

a. Systems that weigh an aircraft and compute a center of gravity (CG) from equipment onboard the aircraft, referred to here as Onboard Weight and Balance Systems (OBWBS), can serve as the primary means of providing weight and balance information for an operator's approved load control program. OBWBS shall be certified to the airworthiness standards of the installations used in the aircraft and be operationally approved. One means, but not the only means, to obtain operational approval to use an OBWBS as the primary means to dispatch an aircraft includes demonstrating the accuracy of the OBWBS is equal to the operator's approved Load Buildup System.

b. Load control programs that use OBWBS shall curtail the operational CG envelope in a similar fashion to load control programs that use the Load Buildup System, where operational CG envelopes are developed using forward and aft CG curtailments appropriate to the system type and methods for establishing the weight and CG for the operations being conducted. An OBWBS approved for primary dispatch eliminates the use of standard baggage and passenger weights as well as assumptions regarding both passenger and baggage/cargo distribution, but does not eliminate the need for a manifest. Load control programs that utilize OBWBS must have provisions that ensure structural limits are not exceeded.

c. When an operator seeks approval of a backup system to an OBWBS, such as systems based on the load buildup process, then the contents of this AC will constitute the appropriate guidance material for approval of that backup system.

3. WEIGHT OF FLUIDS. The weight of all fluids used in the aircraft may be established on the basis of actual weight, a standard volume conversion, or a volume conversion utilizing appropriate temperature correction factors to accurately determine the weight by computation of the quantity of fluid aboard.

4. CONTENT OF OPERATIONS SPECIFICATIONS PROCEDURES FOR AIRCRAFT WEIGHT AND BALANCE CONTROL.

a. Operations Specification Part A & E (OpSpec A011, A096, and E096) authorizes an operator to use its weight and balance control program. Some of the issues addressed by OpSpec A & E are: what average passenger and bag weights will be used, when their use is appropriate, and when they are not; how charter flights and special groups will be handled; what type of loading schedule will be used and instructions for its use; the establishment of an airplane weighing schedule; and other procedures that may be required to assure operational weight and balance control.

b. For operators of airplanes used only in the transportation of cargo, OpSpec E will have text addressing issues specific to cargo operations. OpSpec E contains only a limited description of the issues to be addressed in an operator's weight and balance program. OpSpec E contains references to one or more separate documents or manuals, which fully define the operator's weight and balance control program.

5. LOADING ENVELOPE CONSTRUCTION

a. Overview. Each operator must construct a "loading envelope" for each type of aircraft being operated. The envelope will include all relevant weight and balance limitations. It will be used to ensure that the aircraft is always operated within appropriate weight and balance limitations, and will include provisions to account for the loading of passengers, fuel, and cargo; the in-flight movement of passengers, aircraft components, and other loaded items; and the usage or transfer of fuel and other consumables. The operator must be able to demonstrate, using reasonable assumptions that are clearly stated, that the aircraft is being operated within its certificated weight and balance limitations. Operators of medium and small cabin aircraft should refer to appendix III for additional guidance.

b. Manufacturer's Certificated Loading Envelope. The construction of the loading envelope will begin with the weight and balance limitations provided by the aircraft manufacturer in the weight and balance manual, type certificate data sheet, or similar approved document. These limitations will include, at minimum, at least the following items, as applicable:

(1) Maximum zero-fuel weight.

(2) Maximum takeoff weight.

(3) Maximum taxi weight.

(4) Takeoff and landing CG limitations.

(5) In-flight CG limitations.

(6) Maximum floor loadings – including both running and per square foot limitations.

(7) Maximum compartment weights.

(8) Cabin shear limitations.

(9) Any other limitations provided by the manufacturer.

c. Curtailments to Manufacturer's Loading Envelope

(1) The operator should restrict or curtail the manufacturer's loading limitations to account for loading variations and in flight movement that are encountered in normal operations. For example, if passengers are expected to move about the cabin in flight, the operator must curtail the manufacturer's CG envelope by an amount necessary to ensure that movement of passengers does not take the aircraft outside its certificated envelope. If the aircraft is loaded within the new, curtailed envelope, it will always be operated within

the manufacturer's envelope, even though some of the loading parameters are not precisely known.

(2) In some cases an aircraft may have more than one loading envelope. Each envelope must have the appropriate curtailments applied for those variables that are expected to be relevant for that envelope. For example, an aircraft might have separate in-flight and takeoff and landing envelopes. Passengers would not be expected to be moving about the cabin during takeoff or landing. Therefore, the takeoff and landing envelope need not be curtailed for passenger movement.

(3) Upon determination of the curtailed version of each envelope, the most restrictive points (for each condition the operator's program will check) generated by an "overlay" of the envelopes will form the aircraft operational envelopes. These envelopes must be observed. By restricting operation to these "operational envelopes," compliance with the manufacturer's certified envelope will be ensured in all phases of flight based upon the assumptions within the curtailment process. Optionally, an operator may choose to not combine the envelopes but observe each envelope independently. However, due to calculation complexity, this is typically only possible through automation of the weight and balance calculation.

d. Curtailment Examples. The following sections provide examples of common loading curtailments. They are only examples. The operator must include curtailments appropriate to the operations being conducted. Each of the items mentioned below is a single curtailment factor. The total curtailment of the manufacturer's envelope is computed by combining the curtailments resulting from each of these factors.

(1) Passengers. The operator must account for the seating of passengers in the cabin. The loading envelope need not be curtailed if the actual seating location of each passenger is known. In this case, the operator must implement procedures to ensure that the assignment of passenger seating is incorporated into the loading procedure. It is recommended that the operator take into account the possibility that some passengers may not sit in their assigned seats.

(i) If the actual seating location of each passenger is not known, the operator may assume that all passengers are seated uniformly throughout the cabin or a specified sub-section of the cabin. If this assumption is made, the operator must curtail the loading envelope to account for the fact that the passenger loading may not be uniform. The curtailment may make reasonable assumptions about the manner in which people distribute themselves throughout the cabin. For example, the operator may assume that window seats are occupied first, followed by aisle seats, followed by the remaining seats (window-aisle-remaining seating). Both forward and rear loading conditions should be considered. That is, the passengers may fill up the window, aisle, and remaining seats from the front of the aircraft to the back, or the back to the front.

(ii) If necessary, the operator may divide the passenger cabin into sub-sections or "zones" and manage the loading of each zone individually. Passengers may be assumed to be sitting uniformly throughout each zone, as long as the curtailments described in the previous paragraph are put in place.

(iii) All such assumptions should be adequately documented.

(2) Fuel. The operator's curtailed loading envelope must account for the effects of fuel. The following are examples of several types of fuel-related curtailments:

(i) Fuel density. A certain fuel density ~~may be~~ assumed and a curtailment may be included to account for the possibility of different fuel density values. Fuel density curtailments only pertain to differences in fuel moment caused by varying fuel volumes, not to differences in total fuel weight. The fuel gauges in most transport category aircraft measure weight, not volume. Therefore, the indicated weight of the fuel load can be assumed to be accurate.

(ii) Fuel movement. The movement or transfer of fuel in flight.

(iii) Fuel usage in flight. The burning of fuel may cause the CG of the fuel load to change. A curtailment may be included to ensure that this change does not cause the CG of the aircraft to move outside of the acceptable envelope.

(3) Fluids. The operator's curtailed CG envelope must account for the effects of lavatory and galley fluids. These factors include such things as:

(i) Use of potable water in flight

(ii) Movement of water or lavatory fluids

(4) In-Flight Movement of Passenger and Crew. The operational envelope must account for the in-flight movement of passengers, crew, or equipment. This may be done by including a curtailment equal to the moment change caused by the motion being considered. It may be assumed that all passengers, crew, and equipment are secured when the aircraft is in the takeoff or landing configuration. Standard operational procedures may be taken into account. Examples of items that can move are:

(i) Flight deck crew members moving to the lavatory. Flight deck crewmembers may move to the most forward lavatory in accordance with the security procedures prescribed for crews leaving the cockpit. Credit may be taken if other crewmember movement taken during such a lavatory trip is offsetting, such as a required cabin crewmember to cockpit.

(ii) Flight attendants moving throughout the cabin.

(iii) Service carts moving throughout the cabin. Operators should take their standard operating procedures into account. If procedures do not dictate otherwise, service carts should be assumed to travel anywhere within the compartment to which they are assigned. If multiple carts are in a given compartment, and no restrictions are placed on their movement, then the maximum number of carts, moving the maximum distance, must be considered. The weight of the number of flight attendants assigned to each cart must also be considered. The assumed weight of each cart may be the maximum anticipated cart load or the maximum design load, as appropriate to the operator's procedures.

(iv) Passengers moving throughout the cabin. Allowances should be made for the possibility that passengers may move about the cabin in flight. The most common would be movement to the lavatory, described below. If a lounge or other passenger gathering area is provided, the operator should assume that passengers move there from the centroid of the passenger cabin(s). The maximum capacity of the lounge should be taken into account.

(v) Passengers moving to the lavatory. Operators should account for the CG change caused by passengers moving to the lavatory. Operators should develop reasonable scenarios for the movement of passengers in their cabins and consider the CG shifts that can be expected to occur. Passengers may generally be assumed to move to the lavatories closest to their seats. In aircraft with a single lavatory, movement from the "most adverse" seat must be taken into account. Assumptions may be made which reflect operator lavatory and seating policies. For example, it may be assumed that coach passengers may only use the lavatories in the coach cabin, if that is the operator's normal policy.

~~In general, passenger movement should be from the "most adverse" position to the lavatory. If there is more than one lavatory, one passenger may be assumed to be moving from the most adverse position and the rest should come from the mid-cabin position. Assumptions may be made which reflect operator seating policies. For example, for a first class/coach configuration (where passengers are required to use the lavatories in their own cabins), one passenger from the front seat in coach and one from mid-cabin may be assumed to move to the aft lavatory. Similarly, one passenger in the most aft row of first class may be assumed to move to the forward lavatory.~~

(8) Movement of Flaps and Landing Gear. If the manufacturer has not already done so, the operator must account for the movement of landing gear, flaps, wing leading edge devices, or any other moveable components of the aircraft. Devices deployed only while in contact with the ground, such as ground spoilers or thrust reversers, may be excluded from such curtailments.

(9) Baggage and Freight. Baggage and freight may be assumed to be loaded at the centroid of each baggage compartment. Operators need not include a curtailment if procedures are used which ensure that the cargo is loaded uniformly throughout each compartment.

CHAPTER 5. STANDARD AVERAGE PASSENGER, BAGGAGE, AND CARGO WEIGHTS

1. INTRODUCTION. The standard average passenger and bag weights presented in this section are acceptable for use by an operator in developing an Approved Weight and Balance Control System. Such a system should also have provisions for the use of nonstandard or actual weights when appropriate, following the guidance provided herein. If an operator determines that the standard average weights are not representative of their operation for some routes or regions, they are encouraged to conduct a survey as detailed in appendix I to establish more appropriate average weights for their operation.

2. STANDARD AVERAGE WEIGHTS.

a. STANDARD AVERAGE PASSENGER WEIGHTS. The following table was developed for use by operators of large cabin aircraft. Operators of medium and small cabin aircraft may use these average weights provided they first review appendix II and III for applicable adjustments and restrictions. The standard passenger weights were derived from the NHANES, the National Health and Nutrition Examination Survey, 1999-2000 (see appendix IV). The survey includes over 9,000 cases of U. S. public examined weight values. This survey provides the average person's weight for 1999-2000. The survey discerned additional criteria per case such as age, gender, body mass, and other body dimensions. The average passenger weights are based upon a 50/50 male to female ratio. All weights include an allowance for clothing, and up to one personal item and one carry-on bag, as described in this chapter.

Standard Average Passenger Weights	Per Passenger
Average summer passenger weight (May 1 – October 31)	190 lb
Average winter passenger weight (November 1 – April 30)	195 lb
Summer male weight	200 lb
Summer female weight	179 lb
Summer child weight	82 lb
Winter male weight	205 lb
Winter female weight	184 lb
Winter child weight	87 lb

Table 5.1. Standard average passenger weights.

NOTE: An operator may use average summer or winter weights, as appropriate, for routes with no seasonal variation.

b. CARRY-ON BAGGAGE. For all group aircraft, the carry-on bag and personal item allowance should be included in the operator's standard average passenger weight.

(1) The allowance for carry-on bags and personal items included in the standard average passenger weights is 16 lb per passenger. This allowance takes into consideration that some passengers will have 2 items on their person; some will have 1 item, and others will not carry anything onto the aircraft. The 16 lb standard average carry-on/personal item is not reducible unless the operator conducts a carry-on/personal item survey.

(2) If an operator determines the average carry-on/personal item allowance of 16 lb is not representative of their operations, the operator may conduct a carry-on bag survey "count" and apply the ratio of passenger carry-on bags to the standard carry-on/personal item average weight allowance of 16 lb. The operator may then apply this new average weight allowance to the standard average passenger weight listed in appendix IV.

(3) For example: If the operator determines through survey that 1/3 of their passengers carry 2 items on board the aircraft (1 carry-on, 1 personal item), 1/3 of their passengers carry 1 personal item or 1 carry-on, and 1/3 of the passengers carry nothing onboard the aircraft, then the following formula could be used:

(i) (1/3 x (16 lb x 2)) + (1/3 x 16 lb) + (1/3 x 0 lb) = 16 lb

NOTE: Appendix II provides additional information regarding the standard carry-on/personal item average weight.

(4) Alternatively, an operator may conduct a survey using the formula contained in appendix I to derive a new carry-on bag/personal item weight allowance and apply the results to the standard average passenger weight.

c. ~~GATE~~ PLANE-SIDE LOADED~~CHECKED~~ BAGGAGE. For large cabin aircraft, each plane-side loaded~~gate-checked~~ bag should be accounted for at a weight of 30 lb in the cargo compartment/bin, unless the operator has current validated survey data, in accordance with appendix I, to support an average weight other than what is prescribed in this AC. The plane-side loaded~~gate-checked~~ bag weight is added to the total weight of the aircraft. No credit to the passenger average weight is allowed for plane-side loaded~~gate checked~~ baggage in large cabin aircraft.

d. NO CARRY-ON BAGGAGE PROGRAMS. If an operator of small or medium cabin aircraft elects to have a no carry-on bag program, then only personal items may be carried on board. The operator may reduce the adult passenger weights in Table 5.1 by 6 lb. Also, any bag that is plane-side loaded~~checked plane-side~~ is considered to weigh 20 lbs. (in lieu of 30 lbs./bag standard or surveyed results of checked baggage). Approval of the program is contingent upon the operator demonstrating that sufficient controls are in place ensuring carry-on bags are not carried on board. ~~For example, baggage checked plane-side are baggage that typically would be carried on to larger aircraft, but do not fit in the overhead bins of the aircraft in the program.~~ All personal items carried on board must be able to fit completely under the passenger seat or in an approved stowage compartment.

(1) Operators with a no carry-on bag program using the standard average passenger weights for large cabin aircraft, may also apply a per passenger credit of 6 lb to the standard average passenger weight listed in paragraph 2(a) of this chapter. This will account for the change in CG when placing a passenger's carry-on bag into the cargo compartment.

(2) However, if a gate agent determines that any bag arriving at the gate should have been a checked bag, no reduction should be made and such bags should be treated as a counter-checked bag and be considered to weigh 30 lb.

3. COMPANY MATERIAL (COMAT) AND USPS MAIL.

a. COMAT. Average weights are not authorized for aircraft parts or company material (COMAT).

b. Mail. All mailbag-manifested weight should be used in determining the weights of mailbag shipments. Should it be necessary to separate (break bulk) a manifested shipment, the FAA would accept the use of estimated weights, provided the total estimated weights equal the manifested mailbag shipment

4. CHECKED BAGGAGE

a. Weight Establishment. An operator may use actual weights or a standard average baggage weight of not less than 30 lb per bag. Average weights less than 30 lb must be documented through a survey as prescribed in appendix I. An operator may establish average baggage weights less than 30 lb predicated on a study of actual baggage weights that consider regional, seasonal, demographic, and route trends.

b. Heavy bags. Operators must account for heavy bags using the standard average weight of 60 lb, survey weights, or actual weights. An operator that chooses to "double-count" the standard checked bag weight to account for a heavy bag must ensure the load manifest accurately reflects the actual bag count.

c. Non-luggage Bags: Non-luggage bags are defined as bags that do not meet the normal criteria for luggage. Examples of non-luggage bags include: golf bags, fishing equipment packages, wheelchairs and strollers in the shipping configuration, windsurfing kits, boxed bicycles, etc.

(1) Operators may use actual, survey, or standard bag weights for non-luggage bags

(2) Non-luggage bags must be secured in such a manner that a load shift to an adjacent zone is improbable.

(3) A method must be established to calculate the effects of any large item, such as a surfboard, which may simultaneously affect more than one compartment.

(4) An operator may establish an average weight for specific non-luggage bags by conducting a survey per the methodology in appendix I.

4. AVERAGE CREW WEIGHT. Operators may elect to use the standard crew weights or opt to conduct a survey to establish a company specific average crewmember weight.

Crew	Average Weight (lb)	Average Weight with baggage (lb)
Flight Deck Crew	190	240
Flight Attendant	170	210
Male Flight Attendant	180	220
Female Flight Attendant	160	200
Crew Roller Bag	30	N/A
Pilot Flight Bag	20	N/A
Flight Attendant Kit	10	N/A

Table 5.2. Average Crew Weight.

a. Flight deck crew weights were calculated by averaging the weights stated on all US first and second class medical certificates. Flight deck crew average weights with baggage were calculated by adding the average flight deck crew weights with one crew roller bag and one pilot flight bag.

b. Flight attendant weights were derived using NHANES data referenced in appendix IV. Flight attendant average weights with baggage were calculated by adding the average flight attendant weight with one crew roller bag and one flight attendant kit.

c. The crew weights can be included in the aircraft basic operating weight or added to the load manifest prepared for each flight.

5. ACTUAL WEIGHT PROGRAMS.

a. Actual weights may be determined by:

(1) Scale weighing of each passenger prior to boarding the aircraft; or

(2) Asking each passenger his/her weight and adding to it a predetermined constant of not less than 10 lb to account for clothing. This constant may be adjusted for an operator on the basis of studies by the operator that considers particular routes and seasonal variations, when applicable. If company personnel perceive that the weight provided is underestimated, they may make a reasonable estimation of the passenger's weight, and then add 10 lb.

(3) Carry-on bags and personal items must be weighed.

b. Operators should record all weights used in determining the load build up when using actual weights.

6. GROUPS THAT DO NOT FIT STANDARD WEIGHT PROFILE.

a. Sports Teams

1. Actual passenger weights should be used for nonstandard weight groups (sports teams, etc.) unless average weights have been established for such groups. When such groups form only a part of the total passenger load, actual weights, or established average weights for the nonstandard group may be used for such exception groups and average weights used for the balance of the passenger load. In such instances, a notation should be made in the load manifest indicating the number of persons in the special group and identifying the group; e.g., football squad, etc.

2. Roster weights may be used for determining the actual passenger weight.

3. A standard allowance of 16 lb per person may be used to account for carry-ons and personal items provided the group meets the operator's carry-on bag profile.

4. If the carry-on bags are representative of the operator's profile but do not meet the number of bags authorized per person, the operator may count bags and use a 16 lb per bag allocation.

5. In cases where the carry-on bags are not representative of the operator's profile, actual weights must be used.

b. Groups that are predominantly male or female should use the standard weights for male or female given in section 2.

c. Military Groups. The Department of Defense (DOD) requires actual passenger and cargo weights be used in computing the aircraft weight and balance for all DOD charter missions. This requirement is specified in DOD Commercial Air Carrier Quality and Safety requirements, 32 CFR part 861.3 (d)(3)(ix) (as revised). FAA approved air carrier weight and balance control programs may be used to account for carry-on/personal items for mixed loads of military and their dependents (such as channel missions). For combat equipped troop charters, the Air Mobility Command (AMC) will provide guidance to account for the additional weight. If company personnel perceive that the weights provided are underestimated, they may make a reasonable estimation of the passenger weights.

CHAPTER 6. OVERSIGHT, REVALIDATION AND REPORTING SYSTEMS

[DRP2]

1. OVERSIGHT

a. In order to provide sufficient oversight of an operator's weight and balance control program, the FAA has divided the approval and oversight responsibility between the principal maintenance inspector (PMI) and the principal operations inspector (POI). Once the operator has gathered sufficient data to support the requested average weights, or recommended program changes, all such data must be submitted to the POI and PMI, as applicable, for approval. Approval of this data is signified by the issuance of the applicable Operations Specifications/Management Specifications (OpSpec/MSpec).

b. Because this advisory circular provides for greater accuracy, more flexibility and the ability for an operator to develop average weights appropriate for their operation. Operators, through the OpSpec/MSpec, can amend their program weights to provide for any combination of standard average, survey derived average, or actual program weights.

c. OpsSpecs/MSpecs paragraph E096 authorizes the operator to have an approved weight and balance control program. This paragraph is issued once the PMI or applicable FAA maintenance inspector has reviewed the operators program in its entirety. This paragraph must be issued before A011, A096, A097, A098 and/or A099 can be issued. The PMI and the operator must sign this paragraph.

d. OpsSpecs/MSpecs paragraph A011 authorizes the operator to have a carry-on bag program. This paragraph provides details regarding the operator's approved carry-on bag program and further defines whether the operator is approved to allow carry-on bags in their aircraft or has a No Carry-on Bag Program. The POI and the operator must sign this paragraph.

e. If an operator chooses to use average weights, one (or more) of the following OpSpec/MSpec paragraphs must be issued. The POI and the operator must sign these paragraphs. (Note: although these paragraphs approve the use of average weights, the operator may at anytime use actual weights)

- Paragraph A097 - Standard Average or Survey Derived Average Weights for Small Cabin Aircraft.
- Paragraph A098 - Standard Average or Survey Derived Average Weights for Medium Cabin Aircraft.
- Paragraph A099 - Standard Average or Survey Derived Average Weights for Large Cabin Aircraft.

Note: Failure to issue one of the above referenced OpSpec/MSpec paragraphs will result in paragraph A004 requiring the use actual weights for a specific aircraft group.

f. If an operator chooses to use only actual weights for all aircraft fleets, OpSpec paragraph A096 must be issued. If A096 is issued, A097, A098 or A099 may not be issued.

g. All operators approved for nonstandard average weights must make available upon request, the documentation and methodology[AE3] used to derive the nonstandard average weights. This data must provide sufficient detail that the average weights can be reproduced by an independent FAA audit. The operator for must retain this data for as long as such weights are included in the approved weight and balance control program.

2. REVALIDATION

a. Operators using a validated and approved average weight other than what is prescribed in this AC should revalidate the survey weight, using the procedures outlined in appendix I, within 36 months of original survey date.

b. The FAA will revalidate the AC average weights every two years to coincide with the release of each National Health and Nutrition Examination Survey (NHANES). Should the NHANES data show a change exceeding ± 2 percent, the standard average weights will be revised.

3. PILOT/AGENT REPORTING SYSTEM. Each operator should implement a reporting system and encourage employees to report any discrepancy in aircraft loading or preparation of the manifest. This should include errors in documentation and calculation, as well as aircraft performance or handling characteristics, which indicate the aircraft weight or CG were not properly computed. Operators should attempt to determine the cause of each occurrence and take appropriate action. This would include a load audit on affected flights or conducting a passenger or bag weight survey in accordance with appendix I if trends indicate it is warranted.

4. ADOPTION OF THIS GUIDANCE. To the extent that a program manager or certificate holder adopts the suggestions contained in this AC, the certificate holder must ensure that, when appropriate, discretionary language such as "should" and "may" is replaced with mandatory language in the operations specifications and in relevant manuals.

James J. Ballough
Director Flight Standards Service

APPENDIX 1.[AF4] PROCEDURES FOR CONDUCTING SURVEYS AND ESTABLISHING AVERAGE WEIGHTS

1. PURPOSE. The purpose of this Appendix is to provide acceptable survey methods for operators to use in determining program average weights and counts.

2. FOCUS.

a. The methodology presented in this appendix may be used to conduct surveys for the purpose of establishing standard average weights for passengers and other normally averaged weight items in lieu of using the standard average values contained in this AC.

b. This appendix also provides guidance on conducting numerical count surveys for the purpose of determining carry-on baggage and adult male and female ratios.

3. DISCUSSION

a. To facilitate aircraft loading within weight and balance limits, the FAA has permitted the use of average weights. This Advisory Circular provides acceptable average weights and other information that may be used in such a system. However, the information presented herein is not applicable to all operators by nature of their operation. Thus, some operators will find the need to perform a survey. The purpose of this appendix is to provide sufficient guidance to facilitate this goal.

b. It is critical that operators ensure that the use of standard average weights for passengers and baggage will not compromise operational safety.

c. When sampling is correctly conducted, relatively small samples allow us to draw reliable inferences about large populations. When designing a sampling system, several elements should be considered:

(1) Sample selection process and type of survey (weights, or counts)
(2) Sample size for desired reliability

3. SAMPLING METHODS

a. Introduction. Averages should be determined by a random sample, such that every member of the group has an equal chance of selection.

b. Sample Selection Procedure. For purposes of this AC, random selection is defined as the selection of items from a given population (passengers, checked-bags, etc), whereby every item in the population has an equal chance of being selected into the sample. It should be noted that unless a sample is selected randomly and is of sufficient size, it is subject to inaccurate portrayal of the overall population. There are a number of random selection methods described in textbooks on statistics. The most basic two are discussed here. Depending on the type of survey being accomplished, the operator may find one or the other to be more appropriate, or may elect to another suitable random selection method from any statistics textbook.

(i) Simple Random Selection. Using this type of process, items such as passenger tickets, baggage claim tickets, etc, are assigned sequential numbers. Once all items are sequentially numbered, a starting number (item) is randomly selected and additional item numbers are selected randomly until the minimum sample size is obtained. Most analytical software packages provide random number selection capability.

(ii) Systematic Random Selection. Using the systematic random selection method, items such as passenger tickets, baggage claim tickets, etc, are sequentially selected by first randomly selecting the first item (e.g., the 5th person in line). All subsequent selections then follow a predetermined or *systematic* process, e.g., every 3rd item number, every 10th item number, etc.

4. DETERMINING SAMPLE SIZE

a. Several factors must be taken into consideration when determining an adequate sample size. These factors include tolerable error (expressed as a percentage), confidence that the tolerable error will not be exceeded (expressed as a confidence level), and the coefficient of variance (expressed as a standard deviation). The more varied the population, the larger the sample size required to obtain a reliable estimate. The sample sizes developed in Table 1 below have been derived from survey data and are based on the tolerable error for listed survey type, and a 95-percentile confidence level.

ITEM	MINIMUM SAMPLE	TOLERABLE ERROR
Adult (Standard Adult/Male/Female)	2700	1%
Child	2700	2%
Bags	1400	2%
Personal Items	1400	2%
Carry-On Bag	1400	2%
Heavy Bag	1400	2%
Gate Checked Items	1400	2%

Table 1. Recommended Sample Size

5. SAMPLING PROCEDURES

a. General Guidelines. Survey dates and times are non-specific, so may be accomplished at the operator's discretion assuming proper consideration of the operator's type of operation, hours of operation, markets served, and frequency of flights on various routes. Surveys should be avoided on any specific holiday [DRP5]unless the operator requests such dates. The Principal Operations Inspector (POI), or responsible FAA operations inspector must be given at least two weeks notice of the planned survey, and provided with the most likely window of survey dates. The inspectors role is to review and accept a mutually agreed upon plan, to oversee the survey process to validate an unbiased plan execution, to review the survey results, and to approve the operator's program through issuance of the Operations Specifications. Operators must ensure that the correct number of valid survey points is obtained. When weighing people, operators must ensure that the scale readout is hidden from public view, and that the data collected remains confidential at all times.

b. Survey Item Selection – All surveys must be conducted in a random fashion. The operator may not bias the selection process under any circumstance. In the case of passenger, carry-on item, and personal item surveys, it is always the passenger's prerogative to deny participation. In this case, it is not acceptable to simply ask the next passenger to participate as a replacement unless the next passenger happens to be a part of the survey plan. The operator should continue to observe the established random survey plan and should make a note of participant refusal. The operator should not estimate the statistics when a passenger does not wish to participate in the survey.

c. Specific Route Surveys – Specific route surveys are accomplished when the operator determines that the average weight on a specific route is not representative of their program average weights. In such cases, it is sufficient to determine the average passenger body weights by conducting the survey in only one travel direction. However, the personal item, carry-on bag, plane-side loaded bag, checked bag and heavy bag surveys must be accomplished for both directions unless the operator can substantiate that there is an insignificant correlation between travel direction and weight/count for these items.

d. Hub and Spoke Operators – Operators with a hub and spoke system may accomplish surveys at their single largest hub or several largest hubs assuming that the selected hub(s) represent at least 30% of the operators traffic. In order to be assured that connecting passengers have an equal opportunity for sample selection, surveys conducted under this paragraph should be conducted inside the security screened area. Sampling may be conducted at specific gates or other specific areas as long as the operator endeavors to survey a representative sample population (e.g., body weights, carry-on bags and/or personal items). For example, it would not be appropriate to conduct a survey at a shuttle type operations gate unless the operator is conducting a specific route survey or the operator is involved only in this type of operation. Items that would not normally accompany the passenger to the airplane should be sampled at the passengers last point of contact with that item, e.g. curb-side check, ticket counter, e-ticket check-in.

e. Point to Point and other types of operators – Operators of this type should conduct surveys at a minimum of their two largest operational airports, and should select enough airports to represent at least 30% of their traffic. In order to be assured that connecting passengers have an equal opportunity for sample selection, surveys conducted under this paragraph should be conducted inside the security screened area. Sampling may be conducted at specific gates or other specific areas as long as the operator endeavors to survey a representative sample population (e.g., body weights, carry-on bags and/or personal items). For example, it would not be appropriate to conduct a survey at a shuttle type operations gate unless the operator is conducting a specific route survey or the operator is involved only in this type of operation. Items that would not normally accompany the passenger to the airplane should be sampled at the passengers last point of contact with that item, e.g. curb-side check, ticket counter, e-ticket check-in.

f. Count versus Weight Surveys – The main difference between these types of survey are in the recorded statistics, and in the data analysis. Both survey types require the operator to determine a random sampling plan, and to follow that plan. For example, in a weight survey, the surveyor might record the weight of the subject sample, but in a count survey, the surveyor might record that one person was heading to a flight with 2 carry-on/personal items.

6. DATA ANALYSIS

a. **Average Weights.** Average weights are determined by summing the values of each individual weight and dividing that total by the number of items summed. If the operator has chosen to determine the total number of points to survey other than what is given in table 1, the operator should compute the sample standard deviation, and the sample accuracy using the following formulas to ensure the error is less than or equal to the tolerable error of table

(i). When the calculated error is greater than the tolerable error provided in table 1, the operator should work with the POI to revise the survey plan and continue the survey process until an acceptable error is achieved.

$$s = \frac{\sqrt{\sum_{j=1}^{n}(x_j - \bar{x})}}{\sqrt{n-1}}$$

Where :

s is the standard deviation

n is the number of points surveyed

x_j is the individual survey weights

$\bar{x}$ is the sample average

$$e = \frac{1.96 * s * 100}{\sqrt{n} * \bar{x}}$$

Where :

e is the tolerable error

Note: Passenger weight values may be rounded to the nearest whole number in pounds, and baggage weights may be rounded to the nearest 0.5 lb. Rounding should be done consistently for all calculations.

b. Count Surveys. Count surveys are normally accomplished to determine ratios such as the carry-on to passenger or male to female ratio. These ratios may be determined by counting the number of items carried onboard, per passenger, and multiplying the ratios by the average weight allowance of a carry-on bag (16 lb) and personal item (16 lb).

Example:

After randomly counting the carry-on and personal items of 2400 passengers, it may have been determined that:

0 of the passengers carried 2 bag onboard the airplane (due to operators policy)
½ of the passengers carried 1 bag onboard the airplane
½ of the passengers carried 0 bag onboard the airplane

The operator may then multiply the ratios by the average weight allowance of each item as shown below:

$(0 \times (2 \times 16)) + (\frac{1}{2} \times 16) + (\frac{1}{2} \times 0) =$ **8 pound allowance**

If the operator's random survey indicated ratios in excess of the standard assumptions provided in chapter 5 of this AC, the results could look something like this:

½ of the passengers carried 2 bag onboard the airplane (due to operators policy)
¼ of the passengers carried 1 bag onboard the airplane
¼ of the passengers carried 0 bag onboard the airplane

The operator may then multiply the ratios by the average weight allowance of each item as shown below:

$(\frac{1}{2} \times (2 \times 16)) + (\frac{1}{4} \times 16) + (\frac{1}{4} \times 0) =$ **20 pound allowance**

The carry-on /personal item allowance must then be added to the average (unburdened) passenger weight.

APPENDIX 2. STANDARD AVERAGE WEIGHTS FOR CHECKED BAGGAGE, HEAVY BAGGAGE, PERSONAL ITEMS, AND CARRY-ON BAGGAGE

1. Standard Average Personal Item and Baggage Weights

Samples of (6981) personal item/carry-on bags, (6309) checked bags, and (690) heavy bags yielded statistics identified in Table 1.and described in paragraphs a, b, and c.

Table 1. Personal Item and Baggage Descriptive Statistics

Items Surveyed	Number	Minimum (lbs)	Maximum (lbs)	Mean (lbs)	Std. Deviation (lbs)
Personal Item/Carry-on Baggage	6981	1.0	59	15.1	8.2
Checked Baggage	6309	1.0	50.00	28.9	10.8
Heavy Baggage	690	50.1	99.40	58.7	7.2

a. <u>Personal Item/Carry-on Baggage</u>

The average weight of a personal item/carry-on bag was 15.1 lbs with a standard deviation of 8.2 lbs. Considering these statistics, 16 lbs per person is a representative average weight for carry-on bags, personal items, and other items, such as coats, umbrellas, reading material, food for immediate consumption, infant seats, and "passenger assist/comfort animals and devices".

b. <u>Checked Baggage</u>

The average weight of a checked bag was 28.9 lbs with a standard deviation of 10.8 lbs. Considering these statistics, 30 lbs per checked bag is a representative average weight.

c. <u>Heavy Baggage</u>

The average weight of a heavy bag was 58.7 lbs with a standard deviation of 7.2 lbs. Considering these statistics, 60 lbs per heavy bag is considered a representative average weight.

APPENDIX 3. STANDARD AVERAGE WEIGHTS AND PROGRAM EVALUATION OF MEDIUM AND SMALL CABIN AIRCRAFT

1. DISCUSSION.

a. The additional scrutiny of medium cabin and small cabin aircraft is statistically driven. Statistical probability dictates that the smaller the sample size, the more the average of the sample will deviate from the average of the larger universe. Because of this, the use of standard average passenger weights in weight and balance programs for small aircraft should be examined.

b. Smaller aircraft also tend to be less forgiving in their acceptance of weight deviations from standard assumed averages. The relevance of a weight change is proportional to the contribution of that change to the total weight buildup of the aircraft. The lighter the aircraft, the more meaningful the deviation from assumed averages becomes.

c. For the purposes of calculating aircraft weight and balance, aircraft fall into 3 size groups as defined in Chapter 3, Section 1. Applicability of guidance in this advisory circular for use of standard weights and loading envelope construction are given in the table below.

Group	Max Certified Number of Passenger Seats	Weight & Balance Small Aircraft Guidance
Large Cabin Aircraft	> 70	None- use AC standard weights
Medium Cabin Aircraft	≥ 30 to 70	Examine program for applicability
Small Cabin Aircraft	> 4 to < 30	Full Evaluation

Table 3.1 – Aircraft Definition and Program Guidance
(Aircraft groups derived by statistical analysis)

2. MEDIUM CABIN AIRCRAFT.

a. For operators of medium cabin aircraft, aircraft originally type certificated for 30 to 70 passenger seats, the operator and their PI's must examine the operators weight and balance control program and determine if additional CG curtailment, as required for small cabin aircraft, is necessary. (Additional CG curtailment is described later in this appendix). The following table provides guidance on program applicability for medium cabin aircraft.

Description of Operation	Suggested Applicability
Operators of medium cabin aircraft historically operated near the forward or aft limits of the operational (curtailed) CG envelope	Actual passenger and baggage weights
	Standard average passenger weight from Appendix 4, loading envelope construction guidance of Chapter 3, plus additional curtailments of Appendix 3, Section 4
	Segmented average passenger weights of Appendix 3, Section 3
Operators of medium cabin aircraft historically operated toward the center of the operational (curtailed) CG envelope	Standard average passenger weight from Appendix 4

Table 3.1a – Medium cabin aircraft applicability guidance

b. Application of medium cabin aircraft relies upon the overall aircraft configuration, intended use of the aircraft and the operator's desire to utilize options to improve accuracy. For instance, if the aircraft is a ~~B767~~ B737 passenger/freight combi with 40 seats, it is not necessary for the operator to consider small aircraft guidelines. Conversely, if the operator wishes to include a 70-seat aircraft in a No Carry-On Baggage Program, it is recommended that the building of the weight & balance program should follow the small aircraft guidelines.

3. SMALL CABIN AIRCRAFT.

a. For aircraft originally type certificated for 29 or less passenger seats, operators may request approval to use any one of the following methods when calculating the aircraft weight and balance.

(1) The operator may, at anytime, use actual passenger and bag weights, or

(2) The operator may forgo the CG curtailment process for variation in passenger weight and use the standard segmented average weights prescribed in Figure 3.2 of this Appendix, or

(3) The operator may use the standard passenger weights prescribed for large cabin aircraft, provided the operator curtails the aircraft CG envelope as prescribed in this appendix.

b. For operators of small cabin aircraft, the following segmented standard passenger weight table may be used for calculating the passenger payload once an operator has determined, through survey, the male/female ratios of their operation.

c. Operators using the segmented passenger weights may use the standard average plane-side loaded bag weights and average checked bag weights provided for No Carry-on Bag Programs, if applicable.~~prescribed in Appendix 4 and the nonstandard average weight provisions prescribed in the main text of the AC~~.

Maximum Passenger Seating Capacity	Maximum Authorized Passenger Ratio per Average Weight		
	50/50	60/40	70/30
2	Use actual or solicited weight values		
3	Use actual or solicited weight values		
4	Use actual or solicited weight values		
5	225	227	229
6 to 8	213	215	217
9 to 11	203	205	207
12 to 16	197	199	201
17 to 25	192	194	196
26 to 30	188	190	192
34 to 53	185	187	189
54 to 70	182	184	186

Figure 3.2 Summer Segmented Average Passenger Weights
(Based on NHANES data; protecting 95 percent confidence level and 1% margin of error)

Note: Add the following corrections to figure 3.2:

- +8 pounds to account for clothing and 1 personal item
- +16 pounds to account for clothing, 1 carry-on and 1 personal item
- +5 pounds for winter season (November 1 to April 30)
- Seating capacity refers to max certificated, not as configured

d. Segmented Chart Example:

(1) An operator has a 30 seat aircraft. Through survey, it is determined that the male/female ratio is 50 percent men and 50 percent women. (If the exact ratio is not depicted on the chart, interpolation is acceptable). The operator does not allow carry-on baggage (see note below chart). The segmented average passenger weight used by the operator is: 196 lb in the summer and 201 lb in the winter.

(2) 50/50 ratio= 188 lb + 8 lb for clothing and 1 personal item = 196 lb summer

(3) 196 lb + 5 lb winter correction = 201 lb winter.

(4) The weights provided for the AC standard passenger weights and the weights contained in this table were derived from the NHANES, the National Health and Nutrition Examination Survey, 1999-2000. The survey includes over 9000 cases of U. S. public examined weight values. This survey provides the average person's weight for 1999-2000. The survey discerned additional criteria per case such age, gender and body mass, and other body dimensions.(See Appendix IV)

NOTE: Use of the AC published standard average weights or operator derived average weights require OpsSpecs/Mspecs paragraph A-11 and E96 that authorizes the use of average weights in an operators approved Weight and Balance Control Program.

4. PROGRAM EVALUATION FOR MEDIUM AND SMALL CABIN AIRCRAFT

a. Additional Curtailment to CG Envelope to Accommodate Variations to Passenger Weights. The creation of a weight and balance program for small aircraft requires an additional curtailment to the center-of-gravity envelope with an additional curtailment for passenger weight variations due to standard deviation and Male/Female passenger ratio. The additional curtailment is defined as a function of:

(1) Standard deviation from the source of the average passenger weight used,

(2) A correction factor from the Table 3.3 provided as a function of passenger seating configuration,

(3) The difference between average adult male and average adult female passenger weights, and

(4) A correction factor to accommodate the measured Male/Female ratio to 95% confidence or assumption of all male passengers (correction factor = 1.0).

b. Use of the correction factor in Table 3.3 ensures a 95 percent confidence to impact of passenger weight variation to CG assuming the window-aisle-remaining seating method of CG curtailment. If the operator chooses to use the passenger cabin zone concept and apply this concept to accountability for variation to passenger weight, they must use the factor in Table 3.3 corresponding to the number of seats in each zone. Use of actual seat assignment (row count) to eliminate the curtailment to variation in passenger seating requires use of the single sample t-factor to 95% confidence for the purposes of curtailing for variations to passenger weight. The single sample t-factor for 95% confidence is 12.7.

No. Seats	2 - abreast	3 - abreast	4 - abreast
5 - 8	2.63	2.99	3.30
9 - 13	2.07	2.31	2.51
14 - 18	1.81	1.99	2.15
19 - 24	1.68	1.83	1.96
25 - 29	1.58	1.71	1.82
30 - 34	1.53	1.65	1.75
35 - 39	1.47	1.57	1.66
40 - 49	1.44	1.54	1.62
50 - 59	1.39	1.48	1.55
60 - 70	1.36	1.44	1.51
All seats when using row count	12.70		

Table 3.3 – Correction Factors for 95 percent Reliability f(seat configuration)

c. The center of gravity envelope must also be protected against the weight differences derived from the male/female gender mix as well as typical weight variation among adult passengers. To accommodate this requirement, it is suggested that the operator consider (1) all passengers to be male or (2) use of a passenger gender survey to provide a male/female passenger ratio to a 95% level of confidence. If the operator chooses to assume all male passengers, then the weight difference between male and female is added to the weight calculated for standard deviation to provide a 100% confidence for male/female gender mix. If the operator chooses to use a Male/Female survey, then they can add the weight difference times the surveyed ratio required to obtain a 95% level of confidence.

d. Calculation of the curtailment passenger weight variation is decided by multiplying the standard deviation by the correction factor and adding the difference between male and female passenger weight. For example, assuming a 47 lbs. standard deviation, the average weight difference between male and female of 21 lbs, (from 1999-2000 NHANES data), surveyed male to female passenger ratio of 78% at 95% confidence and a Beech 1900 with 19 seats in a 2-abreast configuration. The additional weight to be curtailed is determined as:

(1) Additional Weight for Curtailment = (47 x 1.68) + (21 x 0.78) = 95 lbs.

e. For the example, the additional curtailment should be accomplished by assuming passenger loading at 95 lbs. using the program method for passenger seating variation (e.g., window-aisle-remaining). Using the window-aisle-remaining method, the additional curtailment in the example is determined to be, 62,310 in-lbs forward and aft. Figure 3.4 displays the calculations used in this example.

Note: The following definitions describe the parameters used in the sample:

- Seat Centroid: Location of passenger weight at seat
- Seat Moment: Additional passenger weight x Seat Centroid
- Total Weight: Sum of additional passenger weights (running total)
- Total Moment: Sum of additional passenger moments
- Moment Deviation: Difference between total moment and moment generated by assuming additional passenger weight is located at the cabin centroid (323.8 in)

Coach Class (Y) Cabin Centroid 323.8

Passenger Weight: 95

Forward Seating					Aft Seating				
Seat Centroid	Seat Moment	Total Weight	Total Moment	Moment Deviation	Seat Centroid	Seat Moment	Total Weight	Total Moment	Moment Deviation
198.0	18,810	95	18,810	-11,950	436.0	41,420	95	41,420	10,660
198.0	18,810	190	37,620	-23,900	436.0	41,420	190	82,840	21,320
228.0	21,660	285	59,280	-33,000	436.0	41,420	285	124,260	31,980
228.0	21,660	380	80,940	-42,100	407.0	38,665	380	162,925	39,885
258.0	24,510	475	105,450	-48,350	407.0	38,665	475	201,590	47,790
258.0	24,510	570	129,960	-54,600	377.0	35,815	570	237,405	52,845
289.0	27,455	665	157,415	-57,905	377.0	35,815	665	273,220	57,900
289.0	27,455	760	184,870	-61,210	347.0	32,965	760	306,185	60,105
318.0	30,210	855	215,080	-61,760	347.0	32,965	855	339,150	62,310
318.0	30,210	950	245,290	-62,310	318.0	30,210	950	369,360	61,790
347.0	32,965	1,045	278,255	-60,105	318.0	30,210	1,045	399,570	61,210
347.0	32,965	1,140	311,220	-57,900	289.0	27,455	1,140	427,025	57,905
377.0	35,815	1,235	347,035	-52,845	289.0	27,455	1,235	454,480	54,600
377.0	35,815	1,330	382,850	-47,790	258.0	24,510	1,330	478,990	48,350
407.0	38,665	1,425	421,515	-39,885	258.0	24,510	1,425	503,500	42,100
407.0	38,665	1,520	460,180	-31,980	228.0	21,660	1,520	525,160	33,000
436.0	41,420	1,615	501,600	-21,320	228.0	21,660	1,615	546,820	23,900
436.0	41,420	1,710	543,020	-10,660	198.0	18,810	1,710	565,630	11,950
436.0	41,420	1,805	584,440	0	198.0	18,810	1,805	584,440	0
				-6.2					6.2

Figure 3.4 – Sample Curtailment Due to Variations in Passenger Weight and Male/Female Ratio Using Window-Aisle Method

5. WEIGHT AND BALANCE PROGRAM – OPTIONS TO IMPROVE ACCURACY.

a. A number of options are available that enable operators to deviate from standard assumed weights and may also provide relief from constraints required when assumed averages are used. These options include:

(1) Surveys. Surveys may be accomplished for passenger weights (to include carry-on bags), checked baggage weights, Male / Female ratios and fuel densities. These surveys may be conducted for entire operator route systems, or by specific market or region. Surveys practices and data reduction must conform to the requirements defined in this AC. If a survey is performed, the operator is required to use the results of the survey to define average weights and to determine curtailments to the CG envelope. Use of surveys may allow an operator to use passenger and baggage weights less than the standard specified in this AC. Also, a survey may find that the assumed Male/Female ratio is incorrect and appropriate adjustments must be made. For example, let’s assume the following results from an approved passenger and baggage survey.

Male passenger weight (M) = 183.3 lbs
Female passenger weight (F) = 135.8 lbs
Difference between Male and Female average passenger weights = 47.5 lbs
Standard deviation (Sigma) = 47.6 lbs
Male/Female ratio (Pax Ratio) = 50.6 percent

95% Male/Female ratio = 78.2 percent
Checked baggage weight = 29.2 lbs
Baggage checked plane-side = 21.3 lbs
Carry-on/personal items weight (CO Wt) = 10.4 lbs
Carry-on/personal items per passenger ratio (CO Ratio) = 0.82
Survey conducted in summer months

The resulting assumed passenger weight for loading is expressed as:

Passenger Weight = M x Pax Ratio + F x (1-Pax Ratio) + CO Wt x CO Ratio

And is determined as:

Summer Passenger Weight = 0.506 x 183.3 + (1-0.506) x 135.8 + 10.4 x 0.82 = 169 lbs.
Winter Passenger Weight = 169 + 5 = 174 lbs.

Survey results would also be used to determine the additional curtailment for variations to passenger weight. Assuming a 19-seat aircraft in 2-abreast configuration in our example, the additional weight to be curtailed would be:

Additional Weight for Curtailment = (47.6 x 1.68) + (47.5 x 0.782) = 117 lbs.

Also in our example, the assumed checked baggage weight is 30 lbs. Plane-side loaded bags would be assumed to weigh 20 lbs. (These weights are the standard average weights provided for a No Carry-on Baggage program as detailed in F).

(2) Actual Weights. It is permissible to use actual weights in lieu of standard average or surveyed weights (if applicable). Candidate parameters that may use actual weights include passenger weights, checked baggage weights, carry-on bag weights, crew weights and fuel density/weight. To ensure a higher degree of accuracy, it is recommended, but not required, that small cabin aircraft use actual bag weights when computing their aircraft weight and balance. Use of actual weights must conform to the methods as described in this AC.

(3) Passenger Cabin Zones and Row Count. Passenger cabins may be split up into zones provided an acceptable procedure for determination of passenger seating is included (e.g., use of seat assignments or crew counts seated passengers by zone). If zones are used, the operator may reduce the CG passenger seating curtailment by accommodating variations within each individual zone separately and totaling the results. Passenger row count allows the operator to eliminate the seating variation by accounting for where the passenger is actually seated.

An example of use of passenger zones follows.

Assume an aircraft interior as displayed in Figure 3.5.

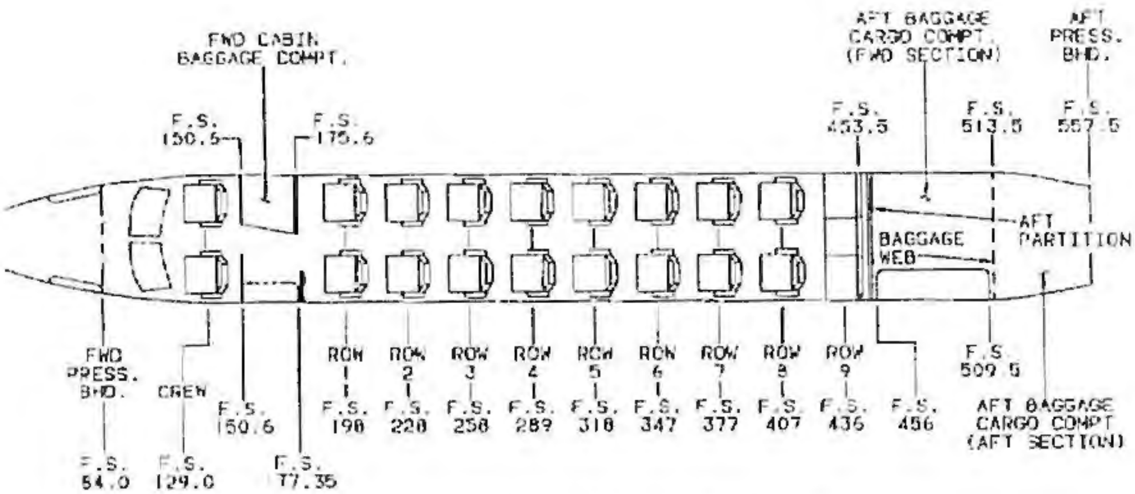

Figure 3.5 – Sample Aircraft Interior Seating Diagram

Assume that for weight and balance purposes, it is desirable to break the cabin up into three passenger zones. The passenger zones will be determined as zone 1 (rows 1-3), zone 2 (rows 4-6) and zone 3 (rows 7-9). Use of the window-aisle remaining method will be utilized in each zone to provide a total curtailment to the CG envelope. (Note: For this sample aircraft, window-aisle-remaining method simply becomes forward and aft end loading). For each zone, a zone centroid must be calculated by taking the total number of seats and averaging their location.

Zone 1 centroid = (2 x 198.0 + 2 x 228.0 + 2 x 258.0) / (2+2+2) = 228.0 in.
Zone 2 centroid = (2 x 289.0 + 2 x 318.0 + 2 x 347.0) / (2+2+2) = 318.0 in.
Zone 3 centroid = (2 x 377.0 + 2 x 407.0 + 3 x 436.0) / (2+2+3) = 410.9 in.

Assuming the standard winter passenger weight of 195 lbs is used for the curtailment, the calculation of total moment is required for comparison to moment assuming each passenger is seated at the centroid of each passenger zone. The total moment is found by summing the individual moments calculated at each occupied seat in the window-aisle progression.

Forward Curtailment Calculations – ZONE 1

PAX	Row	Arm	Total Moment	Zone Centroid	Zone Moment	Delta Moment
1	1	198.0	38,610	228.0	44,460	-5,850
2	1	198.0	77,220	228.0	88,920	-11,700
3	2	228.0	121,680	228.0	133,380	-11,700
4	2	228.0	166,140	228.0	177,840	-11,700
5	3	258.0	216,450	228.0	222,300	-5,850
6	3	258.0	266,760	228.0	266,760	0

Forward Curtailment Calculations – ZONE 2

PAX	Row	Arm	Total Moment	Zone Centroid	Zone Moment	Delta Moment
1	4	289.0	56,355	318.0	62,010	-5,655
2	4	289.0	112,710	318.0	124,020	-11,310

3	5	318.0	174,720	318.0	186,030	-11,310
4	5	318.0	236,730	318.0	248,040	-11,310
5	6	347.0	304,395	318.0	310,050	-5,655
6	6	347.0	372,060	318.0	372,060	0

Forward Curtailment Calculations – ZONE 3

PAX	Row	Arm	Total Moment	Zone Centroid	Zone Moment	Delta Moment
1	7	377.0	73,515	410.9	80,117	-6,602
2	7	377.0	147,030	410.9	160,234	-13,204
3	8	407.0	226,395	410.9	240,351	-13,956
4	8	407.0	305,760	410.9	320,469	-14,709
5	9	436.0	390,780	410.9	400,586	-9,806
6	9	436.0	475,800	410.9	480,703	-4,903
7	9	436.0	560,820	410.9	560,820	0

The curtailment for passenger seating variation is determined by adding the largest delta moments from each of the passenger zones. In our example, the curtailment to the forward CG limit for passenger seating variation is –37,719 in-lbs. (-11,700 + -11,310 + -14,709). Similarly, curtailment to the aft limit of the CG envelope using window-aisle method loading from the most aft seat row moving forward (in each zone) would result in an adjustment of 37,719 in-lbs. Figures 3.6.1 through 3.6.3 graphically shows the curtailments for each passenger zone through use of ~~window-aisle~~ forward and aft end loading using our example.

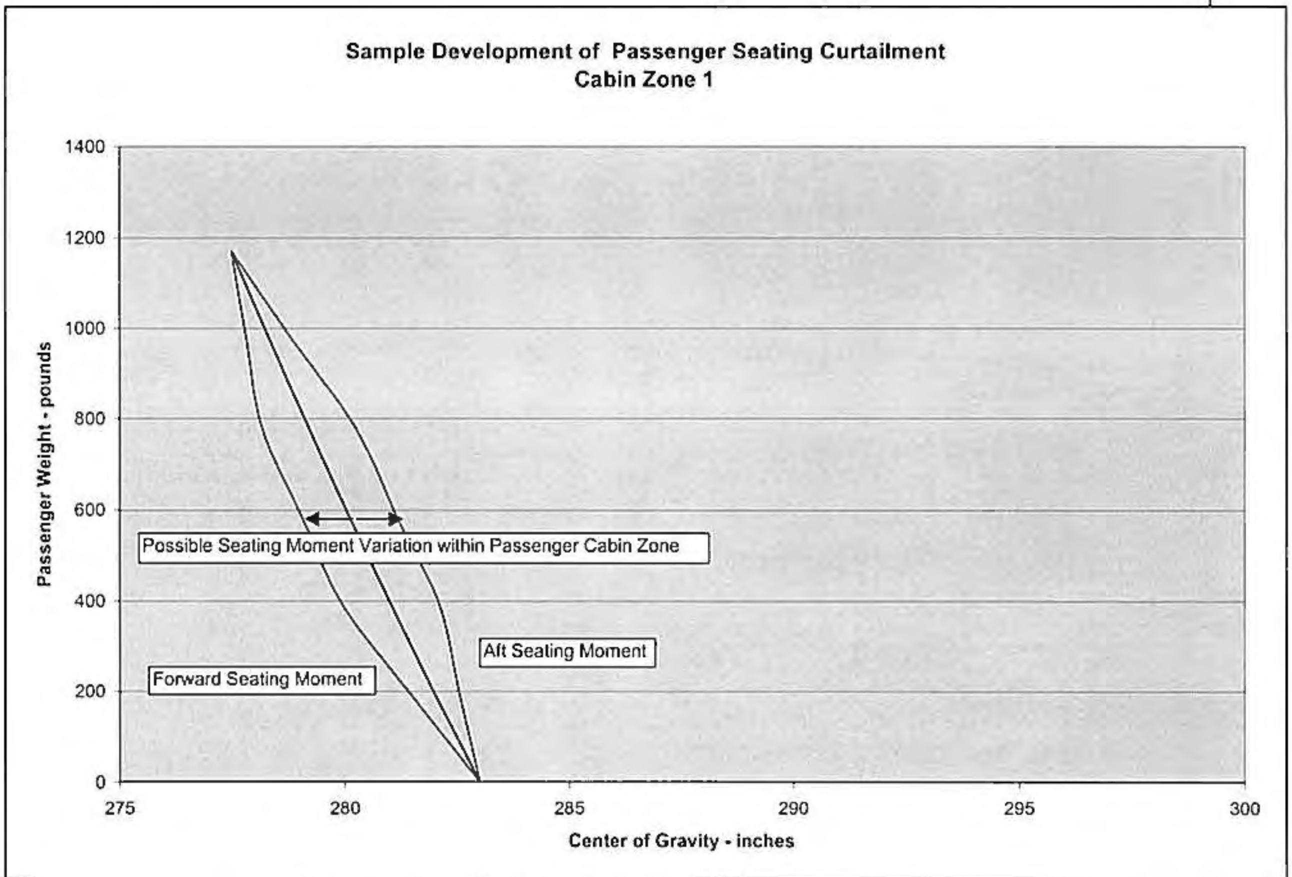

Figure 3.6.1 – Sample Passenger Seating Moment

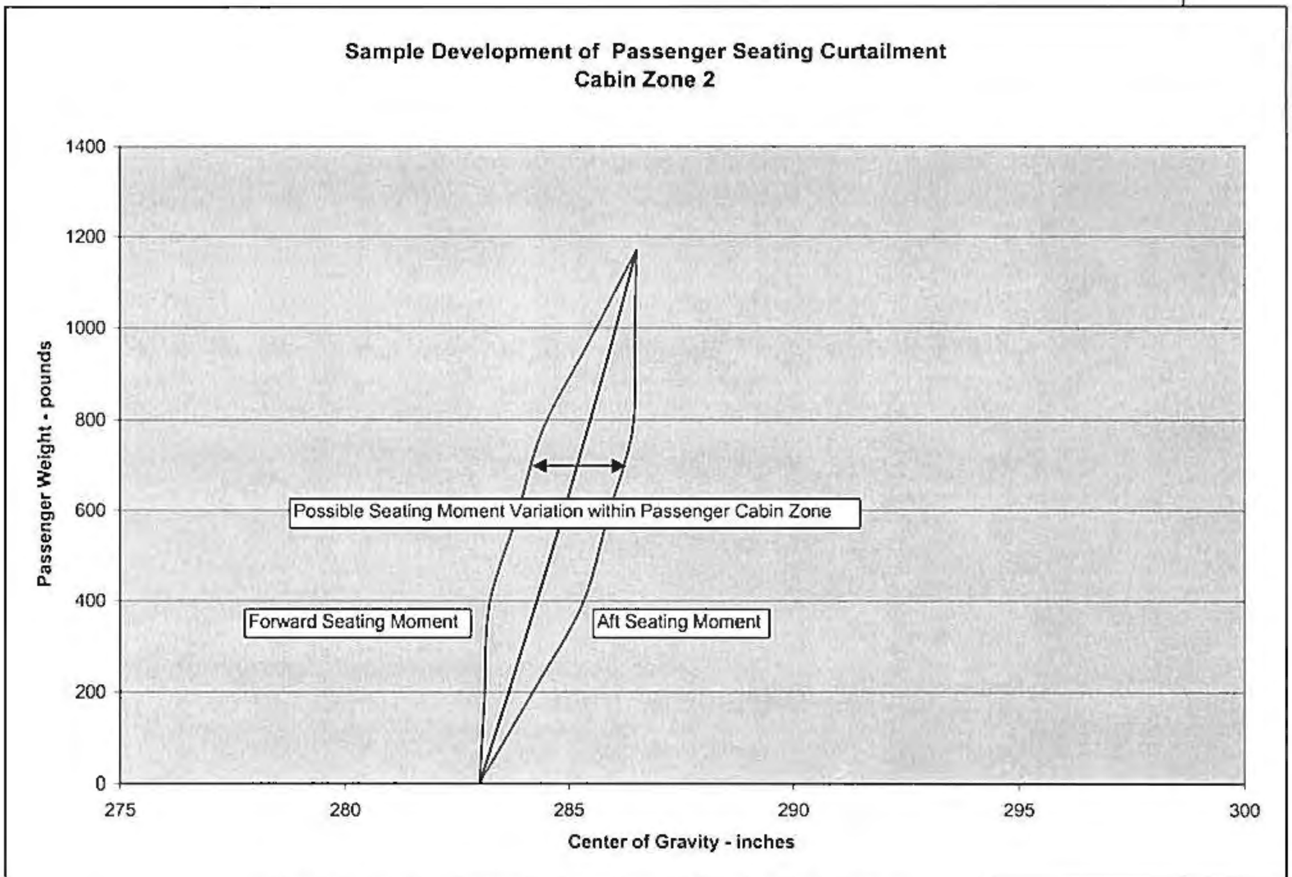

Figure 3.6.2 – Sample Passenger Seating Moment

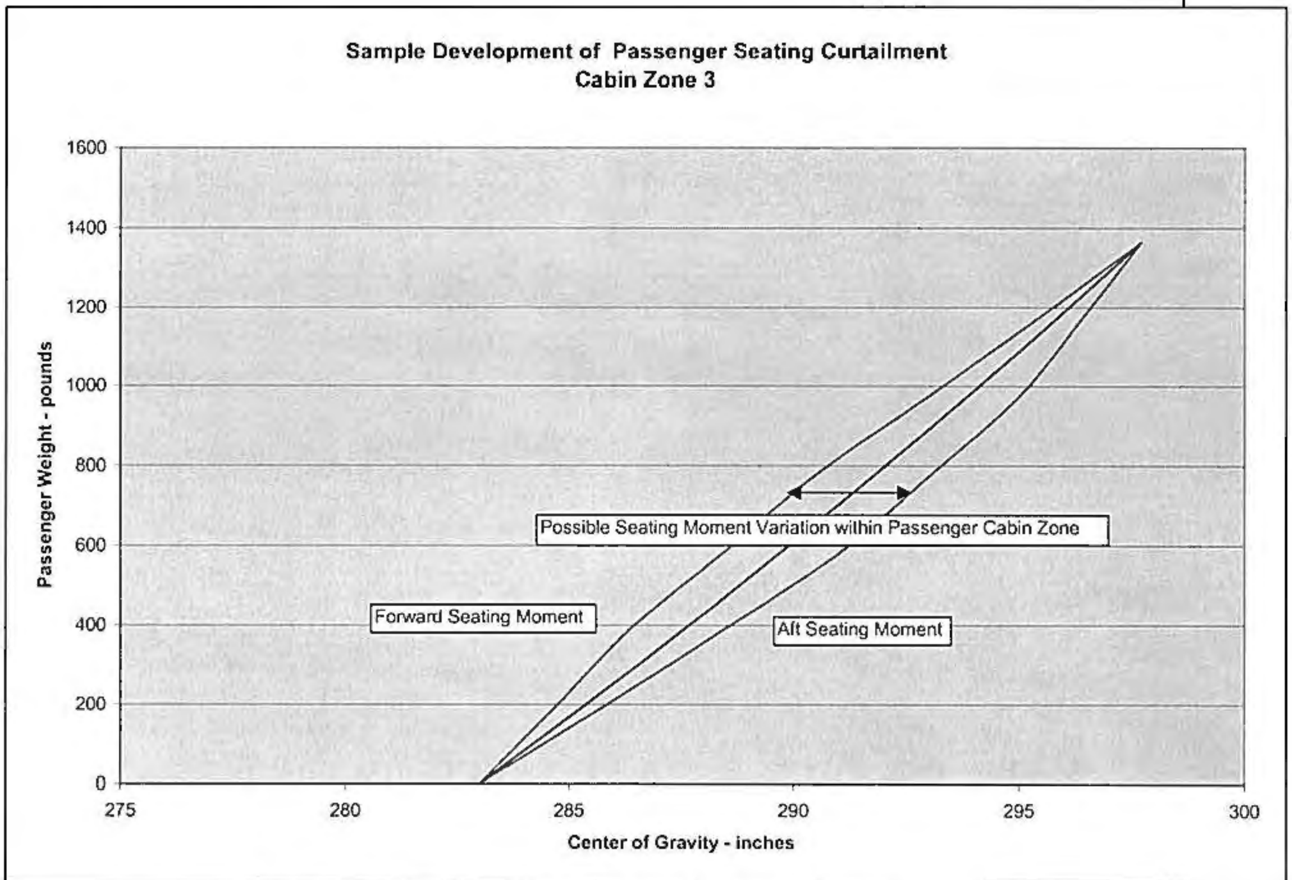

Figure 3.6.3 – Sample Passenger Seating Moment

(4) Actual M/F Counts. Loading systems may use separate Male and Female assumed passenger weights for each operation. If the operator's weight and balance program is approved for use of Male/Female weights, then the operator must count the number of male passengers and female passengers separately. The Male and Female weights used may be from the development of standard passenger weight as described in this AC or they may be determined through an operator-developed survey as also described in this AC. Use of Male/Female weights may be for entire operations or for a particular route and/or region of flying.

An example of how Male/Female ratios can be applied to weight and balance systems follows.

Assuming the operator is using the survey results as described in A above, the assumed Male and Female passenger weights including average carry-on baggage are computed as:

Male passenger weight (summer) = 183.3 + 10.4 x 0.82 = 192 lbs.
Male passenger weight (winter) = 192 + 5 = 197 lbs.

Female passenger weight (summer) = 135.8 + 10.4 x 0.82 = 144 lbs.
Female passenger weight (winter) = 144 + 5 = 149 lbs.

The weight and balance manifest would provide for identification of Male / Female identification and the passenger weights would be summed accordingly. For instance, 7 male passengers and 11 female passengers would result in a total passenger weight of (7 x 192) + (11 x 144) = 2,928 lbs.

(5) Adolescent (Child) Weights. An operator may consider any passenger less than 13 years of age who is occupying a seat to weigh less than an adult passenger as described in this AC.

Standard Weights with Approved No Carry-on Baggage Program

Summer Passenger Weight = 184 lbs.
Winter Passenger Weight = 189 lbs.
Checked Baggage Weight = 30 lbs/ea.
Baggage Checked Plane-side = 20 lbs/ea.

Inclusion in the No Carry-on Baggage Program does not preclude use of actual or surveyed weights for passengers, carry-on/personal items, checked baggage or baggage checked plane-side.

(6) Automation. Automation may also be used to provide a more accurate weight and balance program. Examples of automation include use of seat assignments for the determination passenger moment and historical seating to determine passenger moment.

Table Summary Table 3.6.1 summarizes available options for the treatment of passenger and baggage weight assumptions.

Weight Parameter	Options	Reference
Passenger Weight Assumption	Standard Average	Defined in Appendix 4
	Actual	
	Segmented	Defined in Appendix 3, Section 3
Adjustments to Passenger Weight	Surveyed Weights	Procedures defined in Appendix 1
	Surveyed M/F Ratio	Procedures defined in Appendix 1
	Actual M/F Ratio	
	Child Weights	Defined in Appendix 4
	No Carry-on Baggage	Defined in Appendix 3, Section 5
Baggage Weights	Standard Average	Defined in Appendix 2
	Actual	
	Surveyed	Procedures defined in Appendix 1
	No Carry-on Baggage	Defined in Appendix 3, Section 5

Table 3.6.1 – Summary of Available Passenger and Baggage Weight Assumption Options

Tables 3.6.2 and 3.6.3 provide curtailment guidelines required to meet the intent of this Advisory Circular with respect to the treatment of small cabin aircraft. Table 3.6.2 references the passenger weight assumption used. Table 3.6.3 references the passenger seating model used to construct the center-of-gravity envelope.

Passenger Weight Assumption			
Actual	**Segmented**	**Surveyed**	**Standard Average**
Not Required	Not Required	Required to meet a 95% confidence level	Required to meet a 95% confidence level

Table 3.6.2 - Guidance to Curtail Center of Gravity Envelope for Variations to Passenger Weights

Passenger Seating Method			
Random – single cabin	**Random – cabin zones**	**Historical Data**	**Row Count**
Required to accommodate random seating throughout full cabin	Required to accommodate random seating within each cabin zone	Required to meet a 95% confidence level	Not Required

Table 3.6.3 - Guidance to Curtail Center of Gravity Envelope for Variations to Passenger Seating

6. SAMPLE WEIGHT AND BALANCE PROGRAM.

Outlined below is a 19-seat aircraft system development including ~~cg~~ CG envelope construction and loading consideration. The sample system uses a CG diagram displayed in inches. Operators' systems may use a variety of methods to display CG diagram, including the Index system described in Chapter 4.

Sample Development of Weight & Balance System for 19-seat aircraft

a. CG Envelope Construction. The certified center-of-gravity envelope provided by the manufacturer must be examined for the following curtailments.

(1) Variations to Passenger Seating. In this example, the window-aisle-remaining method was used considering a passenger weight of 189 lbs. and utilizing 3 passenger zones, where zone 1 is defined as rows 1-3, zone 2 is defined as rows 4-6 and zone 3 is defined as rows 7-9. (189 lbs/pax is used since the operator will be using a No Carry-on Baggage Program as detailed later on in this sample exercise). The resulting curtailment for use of 3 passenger zones is 36,600 in-lbs forward and aft.

(2) Variations to Passenger Weight. Since the sample aircraft falls into the group of aircraft requiring full evaluation of Small Cabin Aircraft rules, application of a curtailment due to variations to passenger weight is required.

(i) Use of Passenger Zone Concept for Curtailment. Considering 3 cabin zones with a minimum of 6 passengers apiece, the required correction factor (Table 2) is 2.41. The correction factor is multiplied by the standard deviation and the difference between average male and average female weights is added to provide the additional weight consideration. In our example, the standard deviation is calculated from the NHANES data as 47 lbs., and the difference between average male and average female weights is 21 lbs. The resulting additional weight for curtailment is calculated as 47 x 2.41 + 21 = 134 lbs. This additional weight is applied per the window-aisle concept for each cabin zone independently and the results are summed to determine the amount of curtailment. In this case, the curtailment is found to be , 25,900 in-lbs forward and aft.

(ii) Use of Row Count for Curtailment. When using row count, the required correction factor is12.7. The correction factor is multiplied by the standard deviation and the difference between average male and average female weights is added to provide the additional weight consideration. In our example, the standard deviation is calculated from the NHANES data as 47 lbs., and the difference between average male and average female weights is 21 lbs. The resulting additional weight for curtailment is calculated as 47 x 12.7 + 21 = 618 lbs. This additional weight is applied at the most forward and aft seat locations and compared to identical weight distributed at the cabin passenger seat centroid to determine the curtailment. The resulting curtailment is determined to be 18,540 in-lbs forward and aft.

(3) Variations to Fuel Density. Since the ~~fuel vector for the~~ loading of fuel ~~is very close to the center-of-gravity~~ does not significantly shift the CG for the aircraft, it is not necessary to correct for variations in fuel density (i.e., the correction is negligible).

(4) Fuel Movement in Flight. Fuel movement has been considered by the manufacturer in the development of the certified envelope, making an additional curtailment unnecessary.

(5) Fluids. The sample aircraft does not have a lavatory and there is no catering.

(6) Baggage & Freight. The sample aircraft provides a baggage web in the aft baggage compartment splitting the compartment into forward and aft sections. In our example, we assume the operator is making full use of this web and the movement of baggage is restricted. No curtailment is necessary.

(7) In Flight Movement of Passengers and Crew. Since there are no flight attendants and no lavatories on the sample aircraft, it is reasonable to assume that the passengers will remain in their seats for the duration of the flight. Therefore, it is not necessary to curtail the limits for passenger and crew in flight movement.

(8) Movement of Flaps and Landing Gear. In the case of the sample aircraft, the manufacturer has included consideration of flap and landing gear movement in the development of the certified envelope. No additional curtailment is necessary.

(9) Fuel Usage. The fuel vector for the sample aircraft provides a small aft movement that requires a –8900 in-lb ~~0.8 inch~~ curtailment to the aft zero fuel weight limits to ensure the aircraft does not exceed the aft limit as fuel is burned. This equates to a -0.8 inch curtailment at an estimated operational empty weight of 11,000 lb with a linear transition to a –0.6 inch curtailment at MZFW of 16,155 lb.

b. Three operational curtailments to the sample aircraft center-of-gravity envelope are required. These are for variations to passenger seating and passenger weight, and fuel burn-off. Figure 3.7 displays the operational center-of-gravity envelope highlighting the required curtailments.

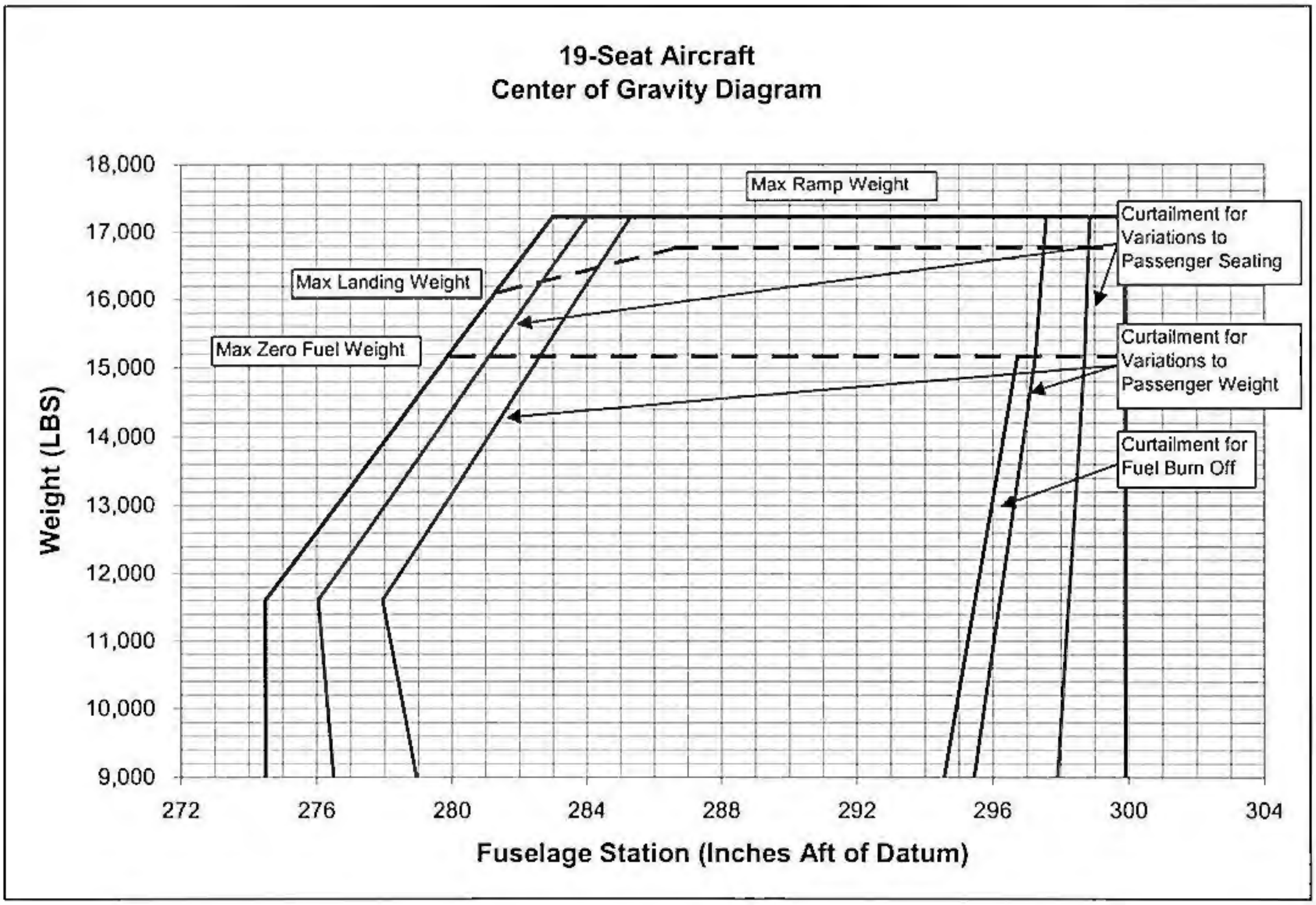

Figure 3.7 – Operational CG Envelope – 3 Pax Zones

c. Assuming operator wishes to widen the envelope, use of actual passenger seating (row count) may be used to eliminate the curtailment required for variations to passenger seating. Figure 3.8 displays a center-of-gravity envelope that makes use of actual passenger seating.

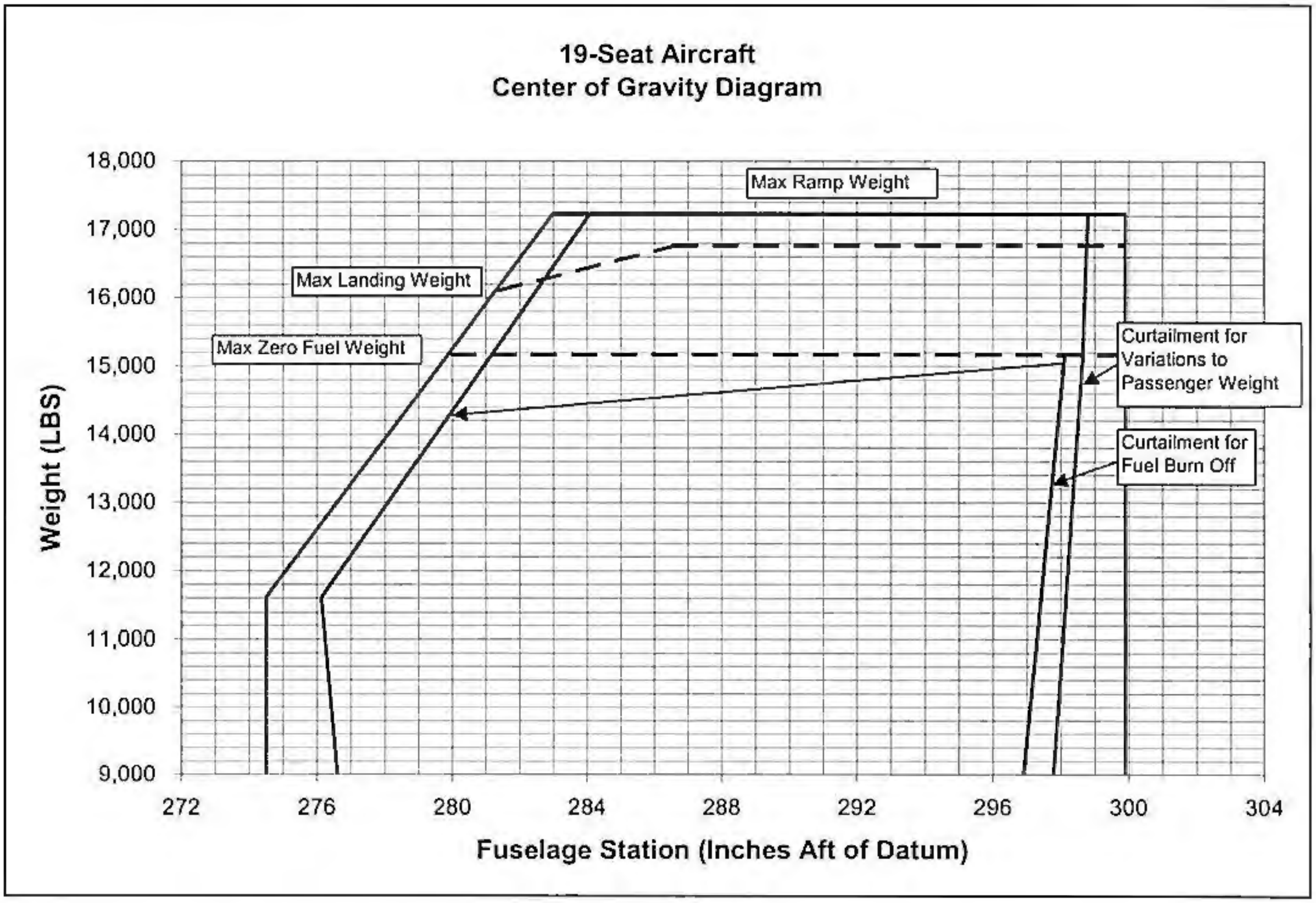

Figure 3.8 – Operational CG Envelope – Actual Passenger Seating

d. No Carry-On Baggage Program. Since the sample aircraft has a limited carry-on capability and it can be demonstrated that only items that can fit under a seat will be carried on with a passenger, the sample aircraft is a candidate for a no carry-on baggage program. This allows consideration of reduced passenger weight to 184 lbs. (summer) and 189 lbs. (winter). Carry-on bBags checked at the gate or "plane-side loaded" will be counted as 20 lbs./bag. Bags checked at the ticket counter will remain at 30 lbs./bag.

e. The example weight and balance loading system utilized the following.

(1) Empty Operating Operational Empty Weight and CG including flight crew, crew books and baggage, unusable fuel/oil and operationally required onboard items. (e.g., 10,800 LBS at 278 inches).

(2) Passengers as seated …

(3) Summer 184 LBS / Winter 189 LBS

(4) Row 1 – 198 inches

(5) Row 2 – 228 inches

(6) Row 3 – 258 inches

(7) Row 4 – 289 inches

(8) Row 5 – 318 inches

(9) Row 6 – 347 inches

(10) Row 7 – 377 inches

(11) Row 8 – 407 inches

(12) Row 9 – 456 inches

(13) Baggage Loading at 30 LBS/checked bag, 20 LBS/bag boarded plane-side

(14) FWD section at 483.5 inches (1000 LBS capacity)

(15) AFT section at 533.0 inches (630 LBS capacity)

(16) Fuel Loading per standard average fuel density (351 USG maximum)

Draft Checklist to be revised and Incorporated by next Steering Committee Meeting

	Aircraft Type	
	Region	
	Route	
	Aircraft Size / Carry-on Bag Assessment	
1	What is the certified maximum number of seats for the aircraft?	
	If answer to (1) greater than 70, then aircraft is large cabin size. Go to question (7). If answer to (1) less than 30, then aircraft is small cabin size. Go to question (3). If answer to (1) is 30 to 70, then aircraft is medium cabin size. Continue with next question.	
2	Is aircraft typically loaded close to forward or aft center of gravity limits? (Yes or No)	
	If answer to (2) is yes, then aircraft weight & balance program should follow small aircraft cabin guideline. If answer to (2) is no, then aircraft weight & balance program may follow large cabin aircraft guidelines.	
3	Can aircraft overhead stowage bins accommodate a large rollerboard carry-on bag? (Yes or No)	
4	Does operator have in place a program that will prohibit placing of carry-on bag in passenger compartment? (Yes or No)	
	If answer to (3) is no or if answer to (4) is yes, then the aircraft is eligible to be included in a no carry-on bag program. If answer to (4) is no, aircraft is not eligible for carry-on bag program.	
5	Aircraft weight & balance program guidelines (Small or Large)	
6	Aircraft eligible for no carry-on bag program? (Yes or No)	
	Passenger Weights Assumptions	
7	Was a valid and current passenger weight survey performed? (Yes or No)	
	The survey may include passenger weights and/or Male/Female ratios. If yes, then the passenger weights used should reflect the results of the survey.	
8	Was a valid and current carry-on bag weight survey performed? (Yes or No)	
	The survey may include checked bag weights and/or counts. If the answer to (8) is yes, then the passenger weights used should reflect survey results.	
9	Will aircraft weight & balance program follow small aircraft guidelines? (Yes or No)	
	If answer to (9) is yes, proceed with next question.If answer is no, go to question (13).	
10	Will segmented passenger weights be used? (Yes or No)	
	If answer to (10) is yes, use passenger weights per Appendix 3 and go to question (12).	
11	Will standard average passenger weights be used? (Yes or No)	
	If answer to (11) is yes, use standard average passenger weights per Chapter 4.	
12	If answer to question (6) is Yes, does operator intend to include aircraft in a no carry-on bag program? (Yes or No)	
	If answer to (12) is yes, adjust passenger weight assumptions by -6 lb/pax.	
13	Will actual, separate Male and Female weights be used? (Yes or No)	
	If answer to (13) is yes, then individual male and female weights should be provided in (15) and (16). If answer to (13) is no, then non-gender specific weights should be provided in (15) and (16).	
14	Will Child weights be used? (Yes or No)	
	If answer to (14) is yes, then child weights should be provided in (15) and (16).	
15	Adult Male Summer Weight (lb)	

	Adult Female Summer Weight (lb)		
	Adult (non-gender specific) Summer Weight (lb)		
	Child Summer Weight (lb)		
16	Adult Male Winter Weight (lb)		
	Adult Female Winter Weight (lb)		
	Adult (non-gender specific) Winter Weight (lb)		
	Child Winter Weight (lb)		
	Checked Bag Weight Assumptions		
17	Was a valid and current checked bag weight survey performed? (Yes or No)		
	If the answer to (17) is yes, then the checked bag weights used should reflect survey results. If no, then standard average checked bag weights as defined in Chapter 4 should be used.		
18	If answer to question (6) is yes, does operator intend to include aircraft in a no carry-on bag program? (Yes or No)		
	If answer to question (18) is yes, then carry-on bags checked planeside should be counted as weighing 20 lb each.		
19	Does operator have an approved heavy bag program?		
	If the answer to (19) is yes, then bags over 50 lb and less than 100 lb are counted as 60 lb. If (19) is no, then actual weights should be used for bags weighing over 50 lb.		
20	Domestic Checked Bag Weight (lb)		
21	International Checked Bag Weight (lb)		
22	Planeside Checked Bag Weight (lb)		
	Center of Gravity Envelope Curtailment		
	Which method of passenger seating assumptions will be used?		
23	- Actual seat assignment (Yes or No)		
	If (23) is yes, then curtailment to the center of gravity envelope for variation in passenger seating not required. If yes, proceed to question (27). It may be appropriate for the operator to provide a small curtailment to accommodate passengers not sitting in their assigned seats if the operator does not have a program in place to ensure passengers are sitting in their assigned seats.		
24	- Random seating with single cabin zone (Yes or No)		
	If (24) is yes, then curtailment to the center of gravity envelope for variation in passenger seating required per a documented method, such as Boeing window-aisle-remaining or Airbus root mean square methods. Passenger weight used in the loading system should be used when developing the curtailments. If yes, proceed to question (27).		
25	- Random seating with multiple cabin zones (Yes or No)		
	If (25) is yes, then curtailment to the center of gravity envelope for variation in passenger seating for each passenger cabin zone is required per a documented method, such as Boeing window-aisle-remaining or Airbus root mean square methods.The curtailments for each passenger cabin zone are summed to provide the total curtailment required for random passenger seating. Passenger weight used in the loading system should be used when developing the curtailments. If yes, proceed to question (27).		
26	- Historically -based (Yes or No)		
	If (26) is yes, then forward and aft curtailments to center of gravity envelope should be calculated to a 95% confidence level based on recorded data. Passenger weight used in the loading system should be used when developing the curtailments.		
27	Will aircraft weight & balance program follow small aircraft guidelines? (Yes or No)		

	If answer to (27) is yes, proceed with next question.If answer is no, go to question (29).		
28	Is response to question (10) Yes? (Yes or No)		
	If answer to (28) is no, curtailment to center of gravity envelope for variation to passenger weight per Appendix 3 is required.		
29	Has aircraft manufacturer included variation to fuel density considerations in the development of the certified center of gravity envelope? (Yes or No)		
	If the answer to (29) is no, then operator should curtail center of gravity envelope for expected variations in fuel density.		
30	Does aircraft's fuel burn moment cause the aircraft to exceed the forward or aft center of gravity limits anytime during flight? (Yes or No)		
	If answer to (30) is yes, then operator should curtail center of gravity envelope to ensure fuel burn will not result in a limit exceedance unless the manufacturer has already considered this in the development of the certified center of gravity envelope.		
31	Has aircraft manufacturer included consideration of fuel movement in the development of the certified center of gravity envelope, e.g., fuel transfer between tanks? (Yes or No)		
	If the answer to (31) is no, then operator should curtail center of gravity envelope for other fuel movement expected in flight.		
32	Does aircraft have galley and/or lavoratory in the cabin? (Yes or No)		
	If answer to (31) is yes, then operator should curtail center of gravity envelope for movement of potable water and/or lavoratory fluids in flight. Operator should also curtail for movement of passengers and crew members to lavoratories and flight attendant with serving cart moving through cabin.		
33	Does the operator use procedures which ensure that the cargo is loaded uniformly throughout each compartment? (Yes or No)		
	If answer to (33) is no, then operator should curtail center of gravity envelope to accommodate expected shifting of cargo load.		

APPENDIX 4. SOURCE OF HUMAN WEIGHT DATA USED IN CALCULATING THE STANDARD AVERAGE PASSENGER WEIGHTS

1. SOURCE. For the purposes of developing a standard average passenger weight this AC employs data gathered by the Centers for Disease Control, National Center for Health Statistics via the National Health and Nutrition Examination Survey (NHANES). . NHANES data is based on actually weighing the person in a clinical setting. It covers a broad spectrum of persons with a large sample and the data is not dependent on a specific route or area.

a. National Health and Nutrition Examination Survey (NHANES)

Web Address:	http://www.cdc.gov/nchs/nhanes.htm
Most Recent Data:	Published – 1994 Available - 2002
Data Source:	Clinical Exam
Approximate Sample Size:	13832 (1988-94 data)
Frequency of Collection:	Yearly

Interpretive Notes: http://www.cdc.gov/nchs/data/nhanes/nhanes3/nh3gui.pdf

2. WEIGHT CALCULATIONS.

In determining a weight or combination of weights to be used in the AC, a method had to be established to take the available data and calculate an average passenger weight.

a. METHODOLOGY. Starting with the NHANES 1999-2000 data (which is the most current data available) currently located on the National Health and Nutrition Examination Survey website (http://www.cdc.gov/nchs/about/major/nhanes/NHANES99_00.htm). From the NHANES website, the following body measures and demographics data files were downloaded.

(1) Body Measures parameters:

(i) SEQN (respondent sequence number which provides link between data files),

(ii) BMXWT (body weight),

(iii) BMIWT (body weight comment).

(2) Demographics parameters:

(i) SEQN (respondent sequence number which provides link between data files),

(ii) RIAGENDR (gender),

(iii) RIDAGEYR (age in years),

(iv) RIDRETH1 (race/ethnicity),

(v) WTMEC2YR (full sample 2 year mec exam weight used to represent U.S. 2000 census population).

(3) DATA FILTERS. Removed samples where BMIWT indicated clothing was worn during weighing.

(4) AGE SEGMENTED.

(i) 13 years (from 13th birthday) and older represent adults

(ii) 2 (from 2nd birthday) through 12 years (up to 13th birthday) represent children.

(5) DATA TRIM. ± 2 standard deviation data trim was applied to adult and child data after census expansion using WTMEC2YR (see note below concerning calculation of standard deviation).

(6) Adult data was sorted by gender to develop a separate male and female weight. For each adult male, BMXWT was multiplied by WTMEC2YR. The sum of the results were divided by the sum of all WTMEC2YR values to produce the final adult male body weight (female weight was developed by same method).

(7) For each child, regardless of gender, BMXWT was multiplied by WTMEC2YR. The sum of the results were divided by the sum of all WTMEC2YR values to produce the final child body weight.

(8) Calculation of Standard Deviation. To calculate the standard deviation which represents the 2000 census data as presented in the NHANES databases, the following formula was employed:

$$s = \sqrt{\frac{\sum\left[(x-\bar{x})^2 \times obs\right]}{n-1}}$$

Where:
$\bar{x}$ = BMXWT mean of untrimmed data set
x = BMXWT of each respondent
obs = WTMEC2YR value of each respondent
n = sum of WTMEC2YR values
s = standard deviation

(9) Stratification Effects on Data Trimming.

(i) In finalizing the data analysis methodology, the working group evaluated the effects of data stratification. "Stratification" refers to the subgroup breakdown upon which standard deviation is calculated and data trimming is conducted. Four different levels of adult data stratification were evaluated with the following average body weight results:

	Body Weight (lbs)		
	Male	Female	50/50
No Stratification	178.5	157.3	167.9
Gender	180.9	160.7	170.8
Gender and Age	177.3	158.0	167.7
Gender, Age and Race	179.8	157.1	168.5

(ii) Given sufficient data counts, stratification by gender, age and race would be preferred but some subgroups become too small to accurately represent the population distribution and thereby bias the standard deviation. Therefore, considering the NHANES sample size, our conclusion is that stratification by Gender and Age provides the most accurate results. However, the "no stratification" method is our final recommended method since results are comparable to Gender/Age and is much easier to maintain.

(iii) No stratification analysis was conducted on child weight data since there is much less variation.

(10) Gender Distribution. Available marketing survey data (Plog Research) indicates that the male/female ratio for most airlines is closer to 50/50, and in fact in some cases there are more females than males. It is recommended that the published gender distribution be based on a 50/50 value.

(11) Passenger Weight Build-up.

(i) weight components used to develop standard average passenger weights are as follows:

(A) Average male: 179 lbs

(B) Average female: 158 lbs

(C) Adult Standard Deviation: 47 lbs

(D) Average child: 61 pounds

(E) Average passenger (50/50 mix): 169 lbs

(F) Average clothing weight: 5 lb summer, 10 lbs winter

(G) Average carry-on weight: 16 lb (based upon specific ratios outlined in Appendix II)

(H) Average personal item weight: 16 lb (based upon specific ratios outlined in Appendix II)

(ii) The fully burdened standard average passenger weight must include the passenger, personal and carry-on items.

Category	Summer	Winter
Average Male	200	205
Average Female	179	184
Average Child (2-12 years of age)	82	87
Average Passenger (50/50)	190	195

APPENDIX 5. AIRCRAFT ONBOARD WEIGHT AND BALANCE SYSTEM

1. PURPOSE. This Appendix 5 provides guidance for the operational approval and use of an Onboard Weight and Balance Systems (OBWBS). It discusses the differences that must be considered for an OBWBS versus the weight buildup system contemplated in the main part of this Advisory Circular.

2. DISCUSSION.

a. Systems that weigh an aircraft and compute a center of gravity from equipment onboard the aircraft can serve as the primary means of providing weight and balance information if it receives certification, airworthiness, and operational approval for use in primary dispatch of the aircraft.

b. This appendix assumes the OBWBS has the necessary certification and airworthiness approvals, and does not duplicate testing and analysis performed under the certification process.

c. The design of the system, system use procedures, weight and balance manual supplement, and system limitations must all appropriately reflect how the weight and CG location communicated by the OBWBS are to be used in dispatch of the aircraft.

3. DEFINITIONS.

a. Load Buildup System. Method of establishing an aircraft's weight and center of gravity with the assumptions established in AC120-27, Aircraft Weight and Balance Control, for example, average passenger weight, average bag weight, male to female passenger ratio, fuel weight.

b. Primary Dispatch System. A system that generates aircraft weight and balance data that will be used to dispatch an aircraft for flight.

d. System. A combination of components, parts, and elements, which are interconnected to perform one or more functions.

e. Load Limit Lines. Lines which operators sometimes place within compartments to control the 'level' to which a compartment is loaded.

f. Backup System. Alternate means of computing aircraft weight and balance for dispatching the aircraft in lieu of the OBWSB.

3. OPERATIONAL ISSUES ASSOCIATED WITH IMPLEMENTATION.

a. Minimum Equipment List (MEL) Relief. MEL relief may be granted to operators provided an acceptable means of Weight and Balance computation is provided as a backup to the OBWBS. Such a backup system would be subject to the same guidance provided in the rest of this Advisory Circular.

b. Load Manifest and Record Keeping Requirements. Requirements for a load manifest and record keeping remain unchanged from those specified under the operating rules under which the aircraft is being operated. However, there are some items that have traditionally been shown on a weight buildup manifest which are not necessarily required on an OBWBS manifest. Examples may include bag counts and individual cargo compartment loads.

c. Baggage Counts and Compartment Structural Limits Compliance. Baggage counts are performed to ensure operators do not exceed compartment limits or Unit Load Device (ULD) limits. Operators seeking to eliminate baggage counts from their load control program may do so in the event the load control program specifies an acceptable means of complying with compartment and ULD limits.

(1) Traditional Method of Showing Compliance. An operator may comply with structural limits by placing a placard or table within the compartment showing the maximum number of standard weight bags the compartment may hold, then performing a baggage count prior to departure. Alternately, a table may also be used that provides weights of specific baggage counts and remaining weight to compartment limit.

(2) Alternate Methods of Demonstrating Compliance. Operators may demonstrate through sample cargo loadings that based upon the average density of the baggage carried, that it is not possible to exceed the structural limits for a compartment and / or ULD limit.

d. Takeoff Trim Settings. If the aircraft manufacturer provides takeoff trim settings based upon CG position, then sufficient information must be provided from the system to enable the crew to determine the appropriate takeoff trim setting.

e. Operational Envelope. The Operational Envelope for OBWBS systems shall be developed using the same procedures described in other parts of this advisory circular, with the exception that the Operational Envelope need not be curtailed for passenger random seating. Also note that the fuel load is subtracted from the measured takeoff weight to determine the zero fuel weight and cg, instead of being added to the zero fuel weight as part of the load buildup.

f. Environmental Conditions. The operator should provide procedures to assure the system is operated within the limits of environmental conditions demonstrated during certification. These may include temperature, barometric pressure, wind, ramp slope, rain, snow, ice, frost, dew, and de-icing fluid.

g. Operational Conditions. The operator should provide procedures to assure the true weight and cg of the aircraft is measured, and is not affected by such things as the position of flaps, stabilizer, doors, stairways, jetway, or ground service connections. Other factors such as engine thrust, oleo strut extension, and taxi movements must be considered in developing the procedures.

h. System Calibration. The requirement for periodic system calibration and associated aircraft weighing should be detailed in the maintenance procedures. These calibration weighings may be done with some fuel and other items on the aircraft to provide for calibration at representative operational weights and do not necessarily eliminate the need for periodic weighing of the empty aircraft as described in the main part of this AC.

i. Demonstrating System Accuracy. A demonstration that the system maintains the certified system accuracy throughout the system calibration period should be performed prior to operational approval, either as part of the certification process or as part of the operational approval process. This need only be done for the first installation of a particular OBWBS system on a particular aircraft type, but the aircraft should be flying in revenue service, or in conditions representative of expected revenue service, during the demonstration.

j. Operations Specifications. Should the operator obtain operational approval for use of an OBWBS, the Operations Specifications may be issued. OpSpec paragraph A096 must be issued to certificate holders and program managers to authorize the use of OBWBS if only using actual weights to derive aircraft weight and balance. If the certificate holder or program manager uses an average weight system as a backup method, one or more of the following OpSpec paragraphs must be issued in place of A096, as these paragraphs authorize the use of actual or average weights: A097, A098, and/or A099.

[DRP1]TOC to be updated only after document is final.
[DRP2]This entire Chapter has been rewritten.
Page: 25
[AE3]NTSB Recommendation
Page: 26
[AE4] The entire appendix 1 has been rewritten and should be reviewed.
[DRP5]The operator determines what days (or timeframe) that a survey shall take place and submits a survey plan for acceptance. At the last meeting, everyone agreed to specific holidays, but not to "periods". The term period is too vague.

U.S. Department
of Transportation
Federal Aviation Administration

AC 120-27D
DATE: 8/11/04
**Initiated By: AFS-200/
AFS-300**

ADVISORY CIRCULAR

AIRCRAFT WEIGHT
AND BALANCE CONTROL

U.S. DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Flight Standards Service
Washington, D.C.

TABLE OF CONTENTS

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CHAPTER 1. INTRODUCTION

100. What is the purpose of this advisory circular (AC)?

a. This AC provides operators with guidance on how to develop and receive approval for a weight and balance control program for aircraft operated under Title 14 of the Code of Federal Regulations (14 CFR) part 91, subpart K of part 91, and parts 121, 125, and 135.

b. This AC presents recommendations for an acceptable means, but not the only means, to develop and receive approval for a weight and balance control program, and includes guidance for using average and estimated weights in accordance with part 121, section 121.153(b) and other applicable parts of subpart K of part 91 and parts 121, 125, and 135.

NOTE: Per part 125, section 125.91(b), no person may operate an airplane in a part 125 operation unless the current empty weight and center of gravity (CG) are calculated from the values established by actual weighing of the airplane within the preceding 36 calendar-months.

c. If an operator adopts the suggestions contained in this AC, the operator must ensure that, when appropriate, it replaces discretionary language such as "should" and "may" with mandatory language in relevant manuals, operations specifications (OpSpecs), or management specifications (MSpecs).

101. How is this AC organized?

This AC has four main chapters and seven appendixes. Chapter 1 contains general information about this AC and background. Chapter 2 addresses aircraft weighing and loading schedules. Chapter 3 describes different methods to determine the weight of passengers and bags. Chapter 4 addresses the Federal Aviation Administration's (FAA) role in developing and approving an operator's weight and balance control program. Finally, appendixes 1 through 7 contain technical information such as definitions, the source of data used in the AC, a sample loading envelope, an example of curtailments to the loading envelope, suggestions to improve accuracy, sample CG envelope development, and checklists for operators.

102. What documents does this AC cancel?

This AC cancels—

a. AC 120-27C, *Aircraft Weight and Balance Control*, dated November 7, 1995; and

b. Joint Handbook Bulletin for Airworthiness (HBAW) 95-14 and Air Transportation (HBAT) 95-15, Adherence to Advisory Circular 120-27C, "Aircraft Weight and Balance Control," dated November 17, 1995.

103. What should an operator consider while reading this AC?

a. Accurately calculating an aircraft's weight and CG before flight is essential to comply with the certification limits established for the aircraft. These limits include both weight and CG limits. By complying with these limits and operating under the procedures established by the manufacturer, an operator is able to meet the weight and balance requirements specified in the aircraft flight manual (AFM). Typically, an operator calculates takeoff weight by adding the operational empty weight (OEW) of the aircraft, the weight of the passenger and cargo payload, and the weight of fuel. The objective is to calculate the takeoff weight and CG of an aircraft as accurately as possible.

b. When using average weights for passengers and bags, the operator must be vigilant to ensure that the weight and balance control program reflects the reality of aircraft loading. The FAA will periodically review the guidance in this AC and update this AC if average weights of the traveling public should change or if regulatory requirements for carry-on bags or personal items should change. Ultimately, the operator is responsible for determining if the procedures described in this AC are appropriate for use in its type of operation.

104. Who should use this AC?

a. This document provides guidance to operators that are either required to have an approved weight and balance control program under parts 121 and 125, or choose to use average aircraft, passenger or baggage weights when operating under subpart K of part 91 or part 135. The guidance in this AC is useful for anyone involved in developing or implementing a weight and balance control program.

b. As shown in Table 1-1, the FAA has divided aircraft into three categories for this AC to provide guidance appropriate to the size of the aircraft.

TABLE 1-1. AIRCRAFT CABIN SIZE

For this AC, an aircraft originally type-certificated with—	Is considered—
71 or more passenger seats	A large-cabin aircraft.
30 to 70 passenger seats	A medium-cabin aircraft.
5 to 29 passenger seats	A small-cabin aircraft.
0 to 4 passenger seats	Not eligible.

105. Who can use standard average or segmented weights?

a. Standard Average Weights. Use of standard average weights is limited to operators of multiengine turbine-powered aircraft originally type-certificated for five (5) or more passenger seats who hold a letter of authorization (LOA), OpSpecs, or MSpecs, as applicable, and were certificated under 14 CFR part 25, 29, or part 23 commuter category or the operator and manufacturer is able to prove that the aircraft can meet the performance requirements of subpart B of part 25. Single-engine and multiengine turbine Emergency Medical Service Helicopter (EMS/H) operators may use standard average weights for EMS operations, provided they have received an LOA.

b. Segmented Weights. Use of segmented weights is limited to those aircraft that meet the requirements of paragraph 105(a) or that are multiengine turbine-powered aircraft originally type-certificated for five (5) or more passenger seats and that do not meet the performance requirements of subpart B of part 25. Segmented passenger weights are listed in Chapter 3, Table 3-5.

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CHAPTER 2. AIRCRAFT WEIGHTS AND LOADING SCHEDULES

Section 1. Establishing Aircraft Weight

200. How does an operator establish the initial weight of an aircraft?

Prior to being placed into service, each aircraft should be weighed and the empty weight and CG location established. New aircraft are normally weighed at the factory and are eligible to be placed into operation without reweighing if the weight and balance records were adjusted for alterations and modifications to the aircraft and if the cumulative change to the weight and balance log is not more than plus or minus one-half of one percent (0.5 percent) of the maximum landing weight or the cumulative change in the CG position exceeds one-half of one percent (0.5 percent) of the mean aerodynamic chord. Aircraft transferred from one operator that has an approved weight and balance program, to another operator with an approved program, need not be weighed prior to use by the receiving operator unless more than 36 calendar-months have elapsed since last individual or fleet weighing, or unless some other modification to the aircraft warrants that the aircraft be weighed (e.g., paragraph 203(c)). Aircraft transferred, purchased, or leased from an operator without an approved weight and balance program, and that have been unmodified or only minimally modified, can be placed into service without being reweighed if the last weighing was accomplished by a method established through an operator's approved weight and balance control program within the last 12 calendar-months and a weight and balance change record was maintained by the operator. See paragraph 203(c) for a discussion of when it may be potentially unsafe to fail to reweigh an aircraft after it has been modified.

201. How does an operator document changes to an aircraft's weight and balance?

The weight and balance system should include methods, such as a log, ledger, or other equivalent electronic means by which the operator will maintain a complete, current, and continuous record of the weight and CG of each aircraft. Alterations and changes affecting either the weight and/or balance of the aircraft should be recorded in this log. Changes to an aircraft that result in a weight being added to the aircraft, weight being removed from the aircraft, or weight being relocated in or on the aircraft should be recorded in such a log. Changes in the amount of weight or in the location of weight in or on the aircraft should be recorded whenever the weight change is at or exceeds the weights listed in Table 2-1.

TABLE 2-1. INCREMENTAL WEIGHT CHANGES THAT SHOULD BE RECORDED IN A WEIGHT AND BALANCE CHANGE RECORD

In the weight change record of a—	**An operator should record any weight changes of—**
Large-cabin aircraft	+/-10 lb or greater.
Medium-cabin aircraft	+/- 5 lb or greater.
Small-cabin aircraft	+/- 1 lb or greater.

202. How does the operator maintain the OEW?

The loading schedule may utilize the individual weight of the aircraft in computing operational weight and balance or the operator may choose to establish fleet empty weights for a fleet or group of aircraft.

a. Establishment of OEW. The OEW and CG position of each aircraft should be reestablished at the reweighing periods discussed in paragraph 203. In addition, it should be reestablished whenever the cumulative change to the Weight and Balance Log is more than plus or minus one-half of 1 percent (0.5 percent) of the maximum landing weight, or whenever the cumulative change in the CG position exceeds one-half of 1 percent (0.5 percent) of the mean aerodynamic chord (MAC). In the case of helicopters and airplanes that do not have a MAC-based CG envelope (e.g., canard equipped airplane), whenever the cumulative change in the CG position exceeds one-half of 1 percent (0.5 percent) of the total CG range, the weight and balance should be reestablished.

b. Fleet Operating Empty Weights (FOEW). An operator may choose to use one weight for a fleet or group of aircraft if the weight and CG of each aircraft is within the limits stated above for establishment of OEW. When the cumulative changes to an aircraft Weight and Balance Log exceed the weight or CG limits for the established fleet weight, the empty weight for that aircraft should be reestablished. This may be done by moving the aircraft to another group, or reestablishing new FOEWs.

203. How often are aircraft weighed?

a. Individual Aircraft Weighing Program. Aircraft are normally weighed at intervals of 36 calendar-months. An operator may, however, extend this weighing period for a particular model aircraft when pertinent records of actual routine weighing during the preceding period of operation show that weight and balance records maintained are sufficiently accurate to indicate that aircraft weights and CG positions are within the cumulative limits specified for establishment of OEW, (see paragraph 202). Such applications should be substantiated in each instance with at least two aircraft weighed. Under an individual aircraft weighing program, an increase should not be granted which would permit any aircraft to exceed 48 calendar-months since the last weighing, including when an aircraft is transferred from one operator to another. In the case of helicopters, increases should not exceed a time that is equivalent to the aircraft overhaul period.

NOTE: Per part 125, section 125.91(b), no person may operate an airplane in a part 125 operation, unless the current empty weight and center of gravity (CG) are calculated from the values established by actual weighing of the airplane within the preceding 36 calendar-months.

b. Fleet Weighing. An operator may choose to weigh only a portion of the fleet and apply the unaccounted weight and moment change determined by this sample to the remainder of the fleet.

(1) A fleet is composed of a number of aircraft of the same model (For example, B747-200s in a passenger configuration and B747-200 freighters should be considered different fleets. Likewise, B757-200s and B757-300s should be considered different fleets). The primary purpose of defining a fleet is to determine how many aircraft should be weighed in each weighing cycle. A fleet may be further divided into groups to establish FOEWs.

TABLE 2-2. NUMBER OF AIRCRAFT TO WEIGH IN A FLEET

For fleets of—	An operator must weigh (at minimum)—
1 to 3 aircraft	All aircraft.
4 to 9 aircraft	3 aircraft, plus at least 50 percent of the number of aircraft greater than 3.
More than 9 aircraft	6 aircraft, plus at least 10 percent of the number of aircraft greater than 9.

(2) In choosing the aircraft to be weighed, the aircraft in the fleet having the most hours flown since last weighing should be selected.

(3) An operator should establish a time limit such that all aircraft in a fleet are eventually weighed. Based on the length of time that a fleet of aircraft typically remains in service with an operator, the time limit should not exceed 18 years (six 3-year weighing cycles). It is not intended that an operator be required to weigh any remaining aircraft in the event that business conditions result in retirement of a fleet before all aircraft have been weighed.

c. Weighing Aircraft—Modifications. For most aircraft modifications, computing the weight and balance changes is practical. For some modifications, such as interior reconfigurations, the large number of parts removed, replaced, and installed make an accurate determination of the weight and balance change by computation impractical. It would be potentially unsafe to fail to reestablish the aircraft weight and balance, by actually reweighing the aircraft, in situations where the cumulative net change in the weight and balance log exceeds:

(1) In the case of airplanes, plus or minus one-half of 1 percent (0.5 percent) of the maximum landing weight, or whenever the cumulative change in the CG position exceeds one-half of 1 percent (0.5 percent) of the MAC.

(2) In the case of helicopters and airplanes that do not have a MAC-based CG envelope (e.g., canard equipped airplane), whenever the cumulative change in the CG position exceeds one-half of 1 percent (0.5 percent) of the total CG range.

NOTE: In the situations specified in paragraphs 203c(1) and (2), the operator should weigh two or more aircraft in a fleet, as required in Table 2-2, to get consistent results. The operator may choose to weigh the aircraft before and after the modification, or just after the modification.

204. What procedures should be used to weigh aircraft?

a. An operator should take precautions to ensure that it weighs an aircraft as accurately as possible. These precautions include checking to ensure that all required items are aboard the aircraft and the quantity of all fluids aboard the aircraft is considered. An operator should weigh aircraft in an enclosed building because scale readings stabilize faster in the absence of drafts from open doors.

b. An operator should establish and follow instructions for weighing the aircraft that are consistent with the recommendations of the aircraft manufacturer and scale manufacturer. The operator should ensure that all scales are certified and calibrated by the manufacturer or a certified laboratory, such as a civil department of weights and measures, or the operator may calibrate the scale under an approved calibration program. The operator should also ensure that the scale is calibrated within the manufacturer's recommended time period, or time periods, as specified in the operator's approved calibration program.

Section 2. Aircraft Loading Schedules

205. What is a loading schedule?

a. The loading schedule is used to document compliance with the certificated weight and balance limitations contained in the manufacturer's AFM and weight and balance manual.

b. The loading schedule is developed by the operator based on its specific loading calculation procedures and provides the operational limits for use with the operator's weight and balance program approved under this AC. These approved operational limits are typically more restrictive but do not exceed the manufacturer's certificated limits. This is because the loading schedule is generally designed to check only specific conditions (e.g., takeoff and zero fuel) known prior to takeoff, and must account for variations in weight and balance in flight. It must also account for factors selected to be excluded, for ease of use, from the calculation process. Loading the aircraft so that the calculated weight and balance is within the approved limits will maintain the actual weight and balance within the certificated limits throughout the flight.

c. Development of a loading schedule represents a trade-off between ease of use and loading flexibility. A schedule can provide more loading flexibility by requiring more detailed inputs, or it can be made easier to use by further limiting the operational limits to account for the uncertainty caused by the less detailed inputs.

d. Several types of loading schedules are commonly-used, including computer programs as well as "paper" schedules, which can be either graphical, such as an alignment ("chase around chart") system, slide rule, or numerical, such as an adjusted weight or index system.

e. It is often more convenient to compute the balance effects of combined loads and to display the results by using "balance units" or "index units." This is done by adding the respective moments (weight times arm) of each item. Graphing the moments results in a "fan grid" where lines of constant balance arms (BA) or % MAC are closer together at lower weights and further apart at higher weights. Direct graphical or numerical addition of the balance effects are possible using these moment values.

f. To make the magnitude of the numbers more manageable, moments can be converted to an index unit. For example:

$$index\ unit = \frac{weight \times (BA - datum)}{M} + K$$

NOTE: Where *datum* is the reference BA that will plot as a vertical line on the fan grid, *M* and *K* are constants that are selected by the operator. *M* is used to scale the index values, and *K* is used to set the index value of the reference BA.

206. How should an operator determine the weight of each fluid used aboard the aircraft?

An operator should use one of the following:

a. The actual weight of each fluid,

b. A standard volume conversion for each fluid, or

c. A volume conversion that includes a correction factor for temperature.

Section 3. Constructing a Loading Envelope

207. What should an operator consider when constructing a loading envelope?

Each operator complying with this AC must construct a "loading envelope" applicable to each aircraft being operated. The envelope will include all relevant weight and balance limitations. It will be used to ensure that the aircraft is always operated within appropriate weight and balance limitations, and will include provisions to account for the loading of passengers, fuel, and cargo; the in-flight movement of passengers, aircraft components, and other loaded items; and the usage or transfer of fuel and other consumables. The operator must be able to demonstrate that the aircraft is being operated within its certificated weight and balance limitations using reasonable assumptions that are clearly stated.

208. What information from the aircraft manufacturer should an operator use?

The construction of the loading envelope will begin with the weight and balance limitations provided by the aircraft manufacturer in the weight and balance manual, type certificate data sheet, or similar approved document. These limitations will include, at minimum, the following items, as applicable:

a. Maximum zero-fuel weight.

b. Maximum takeoff weight.

c. Maximum taxi weight.

d. Takeoff and landing CG limitations.

e. In-flight CG limitations.

f. Maximum floor loadings—including both running and per square foot limitations.

g. Maximum compartment weights.

h. Cabin shear limitations.

i. Any other limitations provided by the manufacturer.

209. What should the operator consider when curtailing the manufacturer's loading envelope?

a. The operator should curtail the manufacturer's loading limitations to account for loading variations and in-flight movement that are encountered in normal operations. For example, if passengers are expected to move about the cabin in flight, the operator must curtail the manufacturer's CG envelope by an amount necessary to ensure that movement of passengers does not take the aircraft outside its certified envelope. If the aircraft is loaded within the new, curtailed envelope, it will always be operated within the manufacturer's envelope, even though some of the loading parameters, such as passenger seating location, are not precisely known.

b. In some cases an aircraft may have more than one loading envelope for preflight planning and loading. Each envelope must have the appropriate curtailments applied for those variables that are expected to be relevant for that envelope. For example, an aircraft might have separate takeoff, in-flight, and landing envelopes. Passengers are expected to remain seated in the cabin during take-off or landing. Therefore, the takeoff and landing envelope need not be curtailed for passenger movement.

c. Upon determination of the curtailed version of each envelope, the most restrictive points (for each condition the operator's program will check) generated by an "overlay" of the envelopes will form the aircraft operational envelopes. These envelopes must be observed. By restricting operation to these "operational envelopes," compliance with the manufacturer's certified envelope will be ensured in all phases of flight, based upon the assumptions within the curtailment process. Optionally, an operator may choose to not combine the envelopes but observe each envelope independently. However, due to calculation complexity, this is typically only possible through automation of the weight and balance calculation.

210. What are some examples of common curtailments to the manufacturer's loading envelope?

The following subparagraphs provide examples of common loading curtailments. They are only examples. Operators using an approved weight and balance control program must include curtailments appropriate to the operations being conducted. Each of the items mentioned below is a single curtailment factor. The total curtailment of the manufacturer's envelope is computed by combining the curtailments resulting from each of these factors.

a. Passengers. The operator must account for the seating of passengers in the cabin. The loading envelope need not be curtailed if the actual seating location of each passenger is known. If assigned seating is used to determine passenger location, the operator must implement procedures to ensure that the assignment of passenger seating is incorporated into the loading procedure. It is recommended that the operator take into account the possibility that some passengers may not sit in their assigned seats.

(1) If the actual seating location of each passenger is not known, the operator may assume that all passengers are seated uniformly throughout the cabin or a specified subsection of the cabin. If this assumption is made, the operator must curtail the loading envelope to account for the fact that the passenger loading may not be uniform. The curtailment may make reasonable assumptions about the manner in which people distribute themselves throughout the cabin. For example, the operator may assume that window seats are occupied first, followed by aisle seats, followed by the remaining seats (window-aisle-remaining seating). Both forward and rear loading conditions should be considered. That is, the passengers may fill up the window, aisle, and remaining seats from the front of the aircraft to the back, or the back to the front.

(2) If necessary, the operator may divide the passenger cabin into subsections or "zones" and manage the loading of each zone individually. It can be assumed that passengers will be sitting uniformly throughout each zone, as long as the curtailments described in the previous paragraph are put in place.

(3) All such assumptions should be adequately documented.

b. Fuel. The operator's curtailed loading envelope must account for the effects of fuel. The following are examples of several types of fuel-related curtailments:

(1) Fuel density. A certain fuel density may be assumed and a curtailment included to account for the possibility of different fuel density values. Fuel density curtailments only pertain to differences in fuel moment caused by varying fuel volumes, not to differences in total fuel weight. The fuel gauges in most transport category aircraft measure weight, not volume. Therefore, the indicated weight of the fuel load can be assumed to be accurate.

(2) Fuel movement. The movement or transfer of fuel in flight.

(3) Fuel usage in flight. The burning of fuel may cause the CG of the fuel load to change. A curtailment may be included to ensure that this change does not cause the CG of the aircraft to move outside of the acceptable envelope.

c. Fluids. The operator's curtailed CG envelope must account for the effects of galley and lavatory fluids. These factors include such things as:

(1) Use of potable water in flight.

(2) Movement of water or lavatory fluids.

d. In-Flight Movement of Passenger and Crew. The operational envelope must account for the in-flight movement of passengers, crew, and equipment. This may be done by including a curtailment equal to the moment change caused by the motion being considered. It may be assumed that all passengers, crew, and equipment are secured when the aircraft is in the takeoff or landing configuration. Standard operational procedures may be taken into account. Examples of items that can move during flight are:

(1) Flight deck crewmembers moving to the lavatory. Flight deck crewmembers may move to the most forward lavatory in accordance with the security procedures prescribed for crews leaving the cockpit. An offsetting credit may be taken if another crewmember moves to the flight deck during such lavatory trip.

(2) Flight attendants moving throughout the cabin.

(3) Service carts moving throughout the cabin. Operators should take their standard operating procedures into account. If procedures do not dictate otherwise, it should be assumed that the service carts can travel anywhere within the compartment to which they are assigned. If multiple carts are in a given compartment, and no restrictions are placed on their movement, then the maximum number of carts, moving the maximum distance, must be considered. The weight of the number of flight attendants assigned to each cart must also be considered. The assumed weight of each cart may be the maximum anticipated cart-load or the maximum design load, as appropriate to the operator's procedures.

(4) Passengers moving throughout the cabin. Allowances should be made for the possibility that passengers may move about the cabin in flight. The most common would be movement to the lavatory, described below. If a lounge or other passenger gathering area is provided, the operator should assume that passengers move there from the centroid of the passenger cabin(s). The maximum capacity of the lounge should be taken into account.

(5) Passengers moving to the lavatory. Operators should account for the CG change caused by passengers moving to the lavatory. Operators should develop reasonable scenarios for the movement of passengers in their cabins and consider the CG shifts that can be expected to occur. Generally, it may be assumed that passengers to move to the lavatories closest to their seats. In aircraft with a single lavatory, movement from the "most adverse" seat must be taken into account. Assumptions may be made which reflect operator lavatory and seating policies. For example, it may be assumed that coach passengers may only use the lavatories in the coach cabin, if that is the operator's normal policy.

e. Movement of Flaps and Landing Gear. If the manufacturer has not already done so, the operator must account for the movement of landing gear, flaps, wing leading edge devices, or any other moveable components of the aircraft. Devices deployed only while in contact with the ground, such as ground spoilers or thrust reversers, may be excluded from such curtailments.

f. Baggage and Freight. It can be assumed that baggage and freight may be loaded at the centroid of each baggage compartment. Operators do not need to include a curtailment if procedures are used which ensure that the cargo is loaded uniformly throughout each compartment.

Section 4. Automated Weight and Balance Systems

211. How does an onboard weight and balance system compare to a conventional weight buildup method?

a. An operator may use an onboard weight and balance system to calculate an aircraft's weight and balance, provided the FAA has approved the system for use in an operator's weight and balance control program. This section discusses the differences an operator should consider when using an onboard weight and balance system compared to a conventional weight buildup method. This section addresses only the operational considerations related to the use of an FAA-authorized onboard weight and balance system.

b. Like operators using a conventional weight buildup method to calculate weight and balance, an operator using an onboard weight and balance system as a primary weight and balance control system should curtail the manufacturer's loading envelope to ensure the aircraft does not exceed the manufacturer's certificated weight and CG limits. However, an operator using an onboard weight and balance system would not need to curtail the loading envelope for assumptions about passenger and bag weight or distribution.

c. Because an onboard weight and balance system measures the actual weight and CG location of an aircraft, an operator may not need to include certain curtailments to the loading envelope to account for variables such as passenger seating variation or variation in passenger weight. However, an operator should curtail the loading envelope for any system tolerances that may result in CG or weight errors. Using an onboard weight and balance system does not relieve an operator from the requirement to complete and maintain a load manifest.

212. What measures should an operator take to obtain operational approval for an onboard weight and balance system?

a. System calibration. An operator should develop procedures to calibrate its onboard weight and balance system equipment periodically in accordance with the manufacturer's instructions. An operator may calibrate its system with operational items or fuel aboard the aircraft to test the system at a representative operational weight. However, an operator may not use an onboard weight and balance system in place of procedures described in Section 1 of this chapter for weighing the aircraft to establish OEW or CG location.

b. Demonstration of system accuracy. As part of the operational approval process, an operator should demonstrate that its onboard weight and balance system maintains its certificated system accuracy between calibration periods. An operator should not have to conduct this demonstration more than once for installing a specific system on one type of aircraft. For the demonstration, the operator should use an aircraft in normal operational service, or in operations that represent the expected environmental and operational conditions in which the aircraft will operate.

213. What operational considerations should an operator take into account when using an onboard weight and balance system?

a. Certification limits. An operator using an onboard weight and balance system as its primary means of calculating weight and balance should have procedures in place to ensure that the system is operated within the limits established during the system's certification process.

b. Environmental considerations. An operator using an onboard weight and balance system should ensure that it uses the system within the environmental limits established by the manufacturer. Environmental conditions that may affect the performance of an onboard weight and balance system include temperature, barometric pressure, wind, ramp slope, rain, snow, ice, frost, dew, deicing fluid, etc.

c. Aircraft considerations. An operator using an onboard weight and balance system should ensure the weight and CG measured by the system are not affected by the aircraft configuration, such as the movement of flaps, stabilizers, doors, stairways or jetways, or any connections to ground service equipment. Other factors that an operator should consider include engine thrust, oleo strut extension, and aircraft taxi movement.

d. Takeoff trim settings. If the aircraft manufacturer provides trim settings for takeoff based on the aircraft's CG location, an operator using an onboard weight and balance system should ensure that the onboard weight and balance system provides flight crewmembers with adequate information to determine the appropriate trim setting.

e. Operational envelope. The operational envelope for onboard weight and balance systems shall be developed using the same procedures described in other parts of this AC, with the exception that the operational envelope need not be curtailed for passenger random seating and passenger weight variance. Also note that the fuel load is subtracted from the measured takeoff weight to determine the zero fuel weight and CG, instead of being added to the zero fuel weight as part of the load buildup. In addition, an operator must curtail the CG envelope for any system CG tolerance and the weight must be curtailed for any system tolerance above 1 percent.

f. Complying with compartment or unit load device (ULD) load limits. When using an onboard weight and balance system, an operator should develop in its weight and balance control program a method to ensure that it does not exceed the load limits specified for a compartment or ULD. If an operator develops appropriate procedures, an operator may request approval to exclude bag counts from its load manifest. The following are two examples of acceptable means to demonstrate compliance with compartment load limits.

(1) An operator may assign a standard average weight to bags. Based on that standard average weight, the operator may place a placard in each compartment stating the maximum number of bags permitted. An operator may also create a table that lists the total weight associated with a given number of bags to ensure the operator does not exceed the load limit of a compartment or ULD.

(2) By conducting sample loadings, an operator may demonstrate that the average density of the bags it places in a compartment or ULD would not allow it to exceed the compartment or ULD load limits inadvertently.

214. May an operator use the information in this AC to develop a backup system?

An operator using an onboard weight and balance system as its primary means of calculating weight and balance may use the guidance in this AC to develop a backup system based on a conventional weight buildup. If an operator develops and receives approval for a backup system, the FAA may grant the operator relief to include an onboard weight and balance system in the operator's minimum equipment list.

215. What operational considerations should an operator take into account when using a computerized weight and balance system?

a. An operator may use an installed computerized weight and balance system to calculate the load schedule for the aircraft's weight and balance for primary dispatch, provided that the system received certification and operational approval for use in an operator's approved weight and balance control program. The system consists of a computer program that runs on installed Electronic Flight Bag computing devices or the Aircraft Communication Addressing and Reporting System, and can be downloaded to ground operations via electronic links. The system displays the load sheet to the pilot or flight operations for primary dispatch.

b. Like operators using a conventional weight buildup method to calculate weight and balance, an operator may use the computerized weight and balance system to provide the FAA approved loading schedules. The operator who uses the computerized weight and balance system as part of its approved weight and balance program should meet all provisions pertinent to the operator's approved weight and balance program as described in this AC.

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CHAPTER 3. METHODS TO DETERMINE THE WEIGHT OF PASSENGERS AND BAGS

Section 1. Choosing the Appropriate Method

300. What should an operator consider when choosing the appropriate method?

a. For many years, operators of transport category aircraft have used average weights for passengers and bags to calculate an aircraft's weight and balance, in accordance with standards and recommended practices. This method eliminates many potential sources of error associated with accounting for a large number of relatively light weights. However, differences between the actual weight of passengers and bags and the average weight of passengers and bags can occur when using average weights.

b. Statistical probability dictates that the smaller the sample size (i.e., cabin size), the more the average of the sample will deviate from the average of the larger universe. Because of this, the use of standard average passenger weights in weight and balance programs for small and medium cabin aircraft should be examined in greater detail.

c. The next four sections describe four methods available to operators to determine passenger and bag weight. They are standard average weights in Section 2; average weights based on survey results in Section 3; segmented weights in Section 4; and actual weights in Section 5. An operator should review the following discussion and consult Table 3-1 to determine which method or methods are appropriate to its type of operation.

d. Large Cabin Aircraft. Operators of large cabin aircraft may use the standard average weights for passengers and bags. If an operator determines that the standard average weights are not representative of its operation for some route or regions, it is encouraged to conduct a survey as detailed in Section 3 of this chapter, to establish more appropriate average weights for its operation. Operators should have procedures for identifying situations that would require the use of nonstandard or actual weights.

e. Medium Cabin Aircraft. Medium cabin aircraft should be evaluated to determine if the aircraft should be treated more like large or small cabin aircraft. To determine if a medium cabin aircraft can be treated as a large cabin aircraft, the aircraft must meet either both of the loadability criteria or the loading schedule criteria or else be subject to the small cabin weights and curtailments:

Loadability Criteria:

- The CG of the OEW is within the manufacturer's loading envelope, and
- The CG of the zero fuel weight is within the manufacturer's loading envelope when loaded with a full load of passengers and all cargo compartments are filled with a density of 10 pounds per cubic foot.

Or

Loading Schedule Criteria:

- The operator must use a loading schedule based upon zones. The aircraft cabin may have no more than four rows per zone with not less then four zones.

f. Small Cabin Aircraft. Operators of small cabin aircraft may request approval to use any one of the following methods when calculating the aircraft weight and balance.

(1) The operator may use actual passenger and bag weights, or

(2) The operator may use the segmented passenger weights listed in Table 3-5 and average bag weights listed in Section 2 of this chapter, or

(3) The operator may use the standard average passenger and bag weights prescribed for large cabin aircraft, or average weights based on an FAA-accepted survey, if—

(a) The aircraft was certificated under part 23 commuter category, part 25, or part 29 (or is able to prove an aircraft has equivalent part 25 or 29 performance data), and

(b) The operator curtails the aircraft CG envelope as prescribed in Appendixes 3 and 4 of this AC.

Section 2. Standard Average Weights

301. What standard average passenger weights should an operator with an approved carry-on bag program use?

a. The standard average passenger weights provided in Table 3-1 were established based on data from U.S. Government health agency surveys. For more background information on the source of these weights, refer to Appendix 2.

b. The standard average passenger weights in Table 3-1 include 5 pounds for summer clothing, 10 pounds for winter clothing, and a 16-pound allowance for personal items and carry-on bags. Where no gender is given, the standard average passenger weights are based on the assumption that 50 percent of passengers are male and 50 percent of passengers are female.

TABLE 3-1. STANDARD AVERAGE PASSENGER WEIGHTS

Standard Average Passenger Weight	Weight Per Passenger
Summer Weights	
Average adult passenger weight	190 lb
Average adult male passenger weight	200 lb
Average adult female passenger weight	179 lb
Child weight (2 years to less than 13 years of age)	82 lb
Winter Weights	
Average adult passenger weight	195 lb
Average adult male passenger weight	205 lb
Average adult female passenger weight	184 lb
Child weight (2 years to less than 13 years of age)	87 lb

c. An operator may use summer weights from May 1 to October 31 and winter weights from November 1 to April 30. However, these dates may not be appropriate for all routes or operators. For routes with no seasonal variation, an operator may use the average weights appropriate to the climate. Use of year-round average weights for operators with seasonal variation should avoid using an average weight that falls between the summer and winter average weights. Operators with seasonal variation that elect to use a year-round average weight should use the winter average weight. Use of seasonal dates, other than those listed above, will be entered as nonstandard text and approved through the operator's OpSpec, MSpec, or LOA, as applicable.

d. The standard average weights listed in Table 3-1 are based on the assumption that the operator has a carry-on bag program. Operators using a no-carry-on bag program should refer to paragraph 305 of this section.

NOTE: The weight of children under the age of 2 has been factored into the standard average and segmented adult passenger weights.

302. What standard average weights should an operator use for carry-on bags and personal items?

a. An operator using standard average passenger weights should include the weight of carry-on bags and personal items in the passenger's weight. The standard average passenger weights in Table 3-1 include a 16-pound allowance for personal items and carry-on bags, based on the assumption that—

(1) One-third of passengers carry one personal item and one carry-on bag.

(2) One-third of passengers carry one personal item or carry-on bag.

(3) One-third of passengers carry neither a personal item nor a carry-on bag.

(4) The average weight allowance of a personal item or a carry-on bag is 16 pounds.

b. If an operator believes the 16-pound allowance for personal items and carry-on bags is not appropriate for its operations or receives notification from the FAA that the assumptions provided in paragraph 302a are not consistent with the operator's approved program, the operator should conduct a survey to determine what percentage of passengers carry personal items or carry-on bags aboard the aircraft. An example of how to adjust the personal item and carry-on bag allowance, based on the results of a survey, is in Section 3. An operator should not use an allowance of less than 16 pounds for personal items and carry-on bags unless the operator conducts a survey or unless the operator has a no-carry-on bag program.

303. What standard average weights should an operator use for checked bags?

An operator that chooses to use standard average weights for checked bags should use a standard average weight of at least 30 pounds. An operator that requests approval to use a standard average weight of less than 30 pounds for checked bags should have current, valid survey data to support a lesser weight. An operator also may conduct a study to establish different standard average bag weights for portions of its operation to account for regional, seasonal, demographic, aircraft, or route variation. For example, an operator could establish different standard average bag weights for domestic and international routes.

a. Heavy bags. Heavy bags are considered any bag that weighs more than 50 pounds but less than 100 pounds. An operator should account for a heavy bag by using one of the following weights:

(1) A standard average weight of 60 pounds,

(2) An average weight based on the results of a survey of heavy bags, or

(3) The actual weight of the heavy bag.

NOTE: An operator that uses "double-counting" to treat a heavy bag as if it were two checked bags for weight purposes should ensure the load manifest represents the actual number of bags for counting purposes. An operator

should have a system in place to ensure that heavy bags are identified, although operators may not be required to weigh heavy bags on a scale.

b. Non-luggage bags. A non-luggage bag is any bag that does not meet the normal criteria for luggage. Examples include golf bags, fishing equipment packages, wheelchairs and strollers in their shipping configuration, windsurfing kits, boxed bicycles, etc. For non-luggage bags, operators may use any appropriate combination of actual weights, average weights based on survey results, or standard average bag weights. Operators that wish to establish an average weight for a particular type of non-luggage bag, such as a golf bag, must conduct a survey in accordance with the procedures established in Section 3 of this chapter. Operators also should establish a method to calculate the effect on CG of a large non-luggage bag, such as a surfboard, that may occupy more than one compartment on the aircraft.

304. What standard average weight should an operator of large cabin aircraft use for bags checked plane-side?

Operators with a carry-on bag program that use standard average weights should account for the weight of each carry-on bag checked plane-side as 30 pounds. An operator may request approval to use a weight other than 30 pounds if the operator has current, valid survey data to support a different average weight for plane-side-loaded bags.

305. What standard average weights should an operator of small and medium cabin aircraft use, if it has a "no-carry-on bag program?"

NOTE: A no-carry-on bag program is limited to small and medium cabin aircraft. A no-carry-on bag program is a term of art created for this AC. Associated with this program are certain standard average weight credits and reductions. Nothing in this AC prevents an operator of large cabin aircraft from having a no-carry-on bag "policy;" however, the acceptable standard bag weights for such checked baggage for large cabin aircraft are outlined in paragraphs 303 and 304 above. Furthermore, the passenger weight credit associated with a no-carry-on-bag program is limited to the small and medium cabin aircraft.

a. An operator with a no-carry-on bag program may allow passengers to carry only personal items aboard the aircraft. Because these passengers do not have carry-on bags, an operator may use standard average passenger weights that are 6 pounds lighter than those for an operator with an approved carry-on bag program. See Table 3-2.

TABLE 3-2. AVERAGE PASSENGER WEIGHTS FOR OPERATORS WITH A NO-CARRY-ON BAG PROGRAM

Average Passenger Weight	Weight Per Passenger
Summer Weights	
Average passenger weight	184 lb
Average male passenger weight	194 lb
Average female passenger weight	173 lb
Child weight (2 years to less than 13 years of age)	76 lb
Winter Weights	
Average passenger weight	189 lb
Average male passenger weight	199 lb
Average female passenger weight	178 lb
Child weight (2 years to less than 13 years of age)	81 lb

b. An operator that has a no-carry-on bag program may account for a plane-side loaded bag as 20 pounds. To receive authorization to use 20 pounds as the average weight for a plane-side loaded bag, an operator should demonstrate that sufficient controls exist to ensure that passengers do not bring carry-on bags aboard the aircraft. An operator also should demonstrate that sufficient controls exist to ensure the personal items brought aboard the aircraft can fit completely under a passenger seat or in an approved stowage compartment.

c. If an operator discovers that a plane-side loaded bag should have been treated as a checked bag, the operator should account for that bag at the standard average weight of 30 pounds for a checked bag.

306. What are the standard average weights for crewmembers?

a. An operator may choose to use the standard crewmember weights shown in Table 3-3 or conduct a survey to establish average crewmember weights appropriate for its operation.

TABLE 3-3. STANDARD CREWMEMBER WEIGHTS

Crewmember	Average Weight	Average Weight with Bags
Flight crewmember	190 lb	240 lb
Flight attendant	170 lb	210 lb
Male flight attendant	180 lb	220 lb
Female flight attendant	160 lb	200 lb
Crewmember roller bag	30 lb	NA
Pilot flight bag	20 lb	NA
Flight attendant kit	10 lb	NA

b. The flight crewmember weights in Table 3-3 were derived from weights listed on all first- and second-class medical certificates. The flight crewmember weight with bags assumes that each flight crewmember has one crewmember roller bag and one pilot flight bag.

c. The flight attendant weights in Table 3-3 were derived from National Health and Nutrition Examination Survey (NHANES) data. (For additional information on NHANES, see Appendix 2.) The flight attendant weights with bags assume that each flight attendant has one crewmember roller bag and one flight attendant kit.

d. An operator may include the weight of crewmembers in an aircraft's OEW or add the weight to the load manifest prepared for each flight.

307. What weights may be used for company materials and mail?

a. Company Material. An operator should use actual weights for company material and aircraft parts carried aboard an aircraft.

b. Mail. An operator should use the weights provided with manifested mail shipments to account for the weight of the mail. If an operator has to separate a shipment of mail, the operator may make actual estimates about the weight of the individual pieces, provided the sum of the estimated weights is equal to the actual manifested weight of the entire shipment.

308. What are the standard average weights for special passenger groups that do not fit an operator's standard average weight profile?

a. Sports Teams.

(1) Actual passenger weights should be used for nonstandard weight groups (sports teams, etc.) unless average weights have been established for such groups by conducting a survey in accordance with the procedures established in Section 3 of this chapter. When such groups form only a part of the total passenger load, actual weights, or established average weights for the nonstandard group, may be used for such exception groups and average weights used for the balance of the passenger load. In such instances, a notation should be made in the load manifest indicating the number of persons in the special group and identifying the group; e.g., football squad, etc.

(2) Roster weights may be used for determining the actual passenger weight.

(3) A standard allowance of 16 pounds per person may be used to account for carry-on and personal items as provided in the operator's approved carry-on bag program.

(4) If the carry-on bags are representative of the operator's profile but do not meet the number of bags authorized per person, the operator may count bags and use a 16 pounds per bag allocation.

(5) Actual weights must be used in cases where the carry-on bags are not representative of the operator's profile.

b. Groups that are predominantly male or female should use the standard average weights for males or females provided in Table 3-1.

c. Military Groups. The Department of Defense (DOD) requires actual passenger and cargo weights be used in computing the aircraft weight and balance for all DOD charter missions. This requirement is specified in DOD Commercial Air Carrier Quality and Safety requirements (reference 32 CFR part 861, section 861.4(e)(3)(ix), as revised). FAA-approved air carrier weight and balance control programs may be used to account for carry-on/personal items for mixed loads of military and their dependents (such as channel missions). For combat-equipped troop charters, the Air Mobility Command (AMC) will provide guidance to account for the additional weight. If aircraft operators perceive that the weights provided are understated, they should seek confirmation of the actual weights and should make reasonable upward estimations and adjustments to those passenger and/or bag weights.

Section 3. Average Weights Based on Survey Results

309. What should an operator consider when designing a survey?

a. This section provides operators with an acceptable survey method to use in determining average weights for a weight and balance control program. This section also describes how an operator can conduct a survey to count personal items and carry-on bags to determine an appropriate allowance for those items to include in passenger weight. In addition, an operator may use the methods described in this section to conduct a survey to determine the percentage of male and female passengers, to calculate an average passenger weight.

b. Surveys conducted correctly allow an operator to draw reliable inferences about large populations based on relatively small sample sizes. In designing a survey, an operator should consider—

(1) The sample size required to achieve the desired reliability,

(2) The sample selection process, and

(3) The type of survey (average weights or a count of items).

310. What sample sizes should an operator use?

Several factors must be considered when determining an adequate sample size. The more varied the population, the larger the sample size required to obtain a reliable estimate. Paragraph 311 provides a formula to derive the absolute minimum sample size to achieve a 95-percent confidence level. Table 3-4 has been provided for those operators that wish to use calculations other than those listed in paragraph 311. Table 3-4 provides the operator with an acceptable number of samples that may be collected to obtain a 95-percent confidence level and lists the tolerable error associated with each category.

TABLE 3-4. MINIMUM SAMPLE SIZES

Survey Subject	Minimum Sample Size	Tolerable Error
Adult (standard adult/male/female)	2,700	1%
Child	2,700	2%
Checked bags	1,400	2%
Heavy bag	1,400	2%
Plane-side loaded bags	1,400	2%
Personal items and carry-on bags	1,400	2%
Personal items only (for operators with no carry-on bag program)	1,400	2%

311. When conducting a survey, can an operator collect a smaller sample size than that published in Table 3-4?

If the operator has chosen to use a sample size that is smaller than that provided in Table 3-4, the operator should collect a sufficient number of samples to satisfy the following formulas:

$$s = \frac{\sqrt{\sum_{j=1}^{n}(x_j - \bar{x})^2}}{\sqrt{n-1}}$$

Where:

s is the standard deviation

n is the number of points surveyed

x_j is the individual survey weights

$\bar{x}$ is the sample average

$$e = \frac{1.96 * s * 100}{\sqrt{n} * \bar{x}}$$

Where:

e is the tolerable error

312. What sampling method should an operator use?

a. An operator conducting a survey must employ random sampling techniques. Random sampling means that every member of a group has an equal chance of being selected for inclusion in the sample. If an operator conducts a survey that does not employ random sampling, the characteristics of the selected sample may not be indicative of the larger group as a whole. Because of this, any conclusions drawn from such a survey may not be valid.

b. The following are two examples of random sampling methods that an operator may find appropriate for the type of survey conducted. An operator may also consult a basic textbook on statistics to determine if another random sampling method is more appropriate.

(1) Simple random selection. An operator should assign a sequential number to each item in a group (such as passengers waiting on a line or bag claim tickets). Then the operator randomly selects numbers and includes the item corresponding with the number in the sample. The operator repeats this process until it has obtained the minimum sample size.

(2) Systematic random selection. An operator should randomly select an item in sequence to begin the process of obtaining samples. The operator should then use a predetermined, systematic process to select the remaining samples following the first sample. For example, an operator selects the third person in line to participate in the survey. The operator then selects every fifth person after that to participate in the survey. The operator continues selecting items to include in the sample until it has obtained the minimum sample size.

c. Regardless of the sampling method used, an operator has the option of surveying each passenger and bag aboard the aircraft and should always give a passenger the right to decline to participate in any passenger or bag weight survey. If a passenger declines to participate, the operator should select the next passenger based on the operator's random selection method rather than select the next passenger in a line. If a passenger declines to participate, an operator should not attempt to estimate data for inclusion in the survey.

313. What should an operator consider when developing a survey plan and submitting it to the FAA?

a. Developing a survey plan. Before conducting a survey, an operator should develop a survey plan. The plan should describe the dates, times, and locations the survey will take place. In developing a survey plan, the operator should consider its type of operation, hours of operation, markets served, and frequency of flights on particular routes. An operator should avoid conducting surveys on holidays unless it has a valid reason to request the particular date.

b. Submitting the survey plan to the FAA. It is recommended that an operator submit its survey plan to the FAA at least 2 weeks before the survey is expected to begin. Before the survey begins, the operator's principal inspectors (PI) will review the plan and work with the operator to develop a mutually acceptable plan. During the survey, the PI will oversee the survey process to validate the execution of the survey plan. After the survey is complete, the PI will review the survey results and issue the appropriate OpSpecs or MSpecs. Once a survey begins, the operator should continue the survey until complete, even if the initial survey data indicates that the average weights are lighter or heavier than expected.

314. What general survey procedures should an operator use?

a. Survey locations. An operator should accomplish a survey at one or more airports that represent at least 15 percent of an operator's daily departures. To provide connecting passengers with an equal chance of being selected in the survey, an operator should conduct its survey within the secure area of the airport. An operator should select locations to conduct its survey that would provide a sample that is random and representative of its operations. For example, an operator should not conduct a survey at a gate used by shuttle operations unless the operator is conducting a survey specific to that route or the operator only conducts shuttle operations.

b. Weighing passengers. An operator that chooses to weigh passengers as part of a survey should take care to protect the privacy of passengers. The scale readout should remain hidden from public view. An operator should ensure that any passenger weight data collected remains confidential.

c. Weighing bags. When weighing bags on a particular flight, an operator should take care to ensure that it is properly accounting for all items taken aboard the aircraft.

d. Rounding sample results. If the operator uses rounding in the weight and balance calculations, it is recommended that the operator round passenger weights to the nearest pound and bag weights to the nearest half-pound. An operator should ensure that rounding is done consistently in all calculations.

e. Surveys for particular routes. An operator may conduct a survey for a particular route if the operator believes that the average weights on that route may differ from those in the rest of its operations. To establish a standard average passenger weight along the route, an operator may survey passengers at only one location. However, an operator should conduct surveys of personal items and bags at the departure and arrival locations, unless the operator can verify there is no significant difference in the weight and number of bags in either direction along the route.

315. What information might an operator gain from conducting a count survey?

a. An operator may conduct a survey to count certain items without determining the weight of those items. For example, an operator may determine that the standard average weights for male and female passengers are appropriate for its operations, but on some routes the passengers are predominantly male or female. In this case, an operator may conduct a survey to determine the percentage of male and female passengers. The operator could use the results of the survey to justify a weight other than the standard weights, which assume a 50-percent male and 50-percent female mix of passengers. Similarly, an operator may conduct a survey to determine the number of personal items and carry-on bags passengers carry aboard aircraft to determine if the allowance of 16 pounds per passenger is appropriate to its operations.

b. For example, an operator conducts a survey on a particular route (or multiple routes if amending the program average weight) to count the percentage of passengers carrying personal items and carry-on bags. The operator finds that—

(1) Fifty percent of passengers carry one carry-on bag and one personal item.

(2) Thirty percent of passengers carry one carry-on bag or one personal item.

(3) Twenty percent of passengers carry neither a carry-on bag nor a personal item.

(4) The survey results show that the average passenger carries approximately 21 pounds of personal items and carry-on bags rather than the standard allowance of 16 pounds. In such a case, it would be irresponsible for the operator to fail to increase the standard average weights for that route(s) by 5 pounds per passenger.

NOTE: The calculation below determines the appropriate allowance for personal items and carry-on bags.

$$[0.50 \times (16 \text{ pounds} + 16 \text{ pounds})] + [0.30 \times (16 \text{ pounds})] + [0.20 \times (0 \text{ pounds})] = 20.8 \text{ pounds}$$

316. When should an operator conduct another survey to revalidate the data from an earlier survey?

In order to use survey-derived average weights, an operator must revalidate such survey data every 36 calendar-months or revert to the standard average weights, provided the new survey average weight results are within 2 percent of the standard average weights listed in this AC.

Section 4. Segmented Passenger Weights

317. What should an operator consider when using segmented weights?

a. The concept of segmented weights involves adding a portion of the standard deviation to an average weight to increase the confidence that the actual weight will not exceed the average weight. Like the standard average weights in Section 2, the segmented weights in Table 3-5 were derived from average weights and standard deviations found based on NHANES data, assuming a 95-percent confidence interval and 1-percent tolerable error.

TABLE 3-5. SEGMENTED WEIGHTS FOR ADULT PASSENGERS (IN POUNDS; SUMMER)

Maximum Certificated Passenger Seating Capacity	Ratio of Male to Female Passengers										
	0/100	10/90	20/80	30/70	40/60	50/50	60/40	70/30	80/20	90/10	100/0
1 to 4	Use actual weights, or asked (volunteered) weights plus 10 lb										
5	231	233	235	237	239	241	243	245	247	249	251
6 to 8	219	221	223	225	227	229	231	233	235	237	239
9 to 11	209	211	213	215	217	219	221	223	225	227	229
12 to 16	203	205	207	209	211	213	215	217	219	221	223
17 to 25	198	200	202	204	206	208	210	212	214	216	218
26 to 30	194	196	198	200	202	204	206	208	210	212	214
31 to 53	191	193	195	197	199	201	203	205	207	209	211
54 to 70	188	190	192	194	196	198	200	202	204	206	208

b. An operator may make the following adjustments to the table above:

(1) An operator may subtract 6 pounds from the passenger weight outlined above if it has a no-carry-on bag program or does not allow any carry-on baggage into the cabin of the aircraft.

(2) An operator should add 5 pounds to the weights above during the winter season.

c. An operator may interpolate between columns on the chart if the operator's assumed ratio of male passengers to female passengers does not exactly match the values given.

d. To account for a child's weight, for children ages 2 years to less than 13 years of age, the standard average child weight located in Table 3-1 may be used. Weights of children under the age of 2 have been factored into the segmented adult passenger weight.

318. How are loading envelope curtailment and bag weight affected by an operator's use of segmented weights?

a. Loading envelope curtailment. An operator using segmented passenger weights should consider curtailing its operational loading envelope using the methods described in Appendix 4.

b. Bag weights. An operator using segmented weights may use actual weights for bags or the standard average bag weights provided in Section 2. An operator using segmented passenger weights *may not* use survey-derived average bag weights.

319. What might be an example be of an operator using the segmented weights in Table 3-5?

An operator of a 30 passenger-seat aircraft conducts a survey to count the percentage of male and female passengers on its flights and determines that 50 percent of its passengers are male and 50 percent are female. If the operator has an approved carry-on bag program, the operator should use 204 pounds in the summer and 209 pounds in the winter. If the operator has a no-carry-on bag program, the operator should use 198 pounds in the summer and 203 pounds in the winter and account for all plane-side loaded bags as 20 pounds each.

Section 5. Actual Weight Programs

320. If the operator decides to use an actual weights program, how might it determine the actual weight of passengers?

An operator may determine the actual weight of passengers by—

a. Weighing each passenger on a scale before boarding the aircraft (types of weight scales and scale tolerances will be defined in the operator's approved weight and balance control program); or

b. Asking each passenger his or her weight. An operator should add to this asked (volunteered) weight at least 10 pounds to account for clothing. An operator may increase this allowance for clothing on certain routes or during certain seasons, if appropriate.

NOTE: If an operator believes that the weight volunteered by a passenger is understated, the operator should make a reasonable estimate of the passenger's actual weight and add 10 pounds.

321. If the operator decides to use an actual weight program, how should it determine the actual weights of personal items and bags?

To determine the actual weight of a personal item, carry-on bag, checked bag, plane-side loaded bag, or a heavy bag, an operator should weigh the item on a scale.

322. What approach should an operator use to record actual weights?

An operator using actual weights should record all weights used in the load buildup.

CHAPTER 4. OPERATOR REPORTING SYSTEMS AND FAA OVERSIGHT

Section 1. Pilot and Agent Reporting Systems

400. What are the pilots' and operators' responsibilities in reporting aircraft loading and manifest preparation discrepancies?

Each operator should develop a reporting system and encourage employees to report any discrepancies in aircraft loading or manifest preparation. These discrepancies may include errors in documentation or calculation, or issues with aircraft performance and handling qualities that indicate the aircraft weight or balance is not accurate. Operators should attempt to determine the cause of each discrepancy and take appropriate corrective action. This would include a load audit on affected flights or conducting a passenger or bag weight survey in accordance with this AC if trends indicate it is warranted.

Section 2. FAA Oversight

401. Which FAA inspectors are responsible for overseeing an operator's weight and balance program?

The FAA has divided the responsibility of overseeing an operator's weight and balance control program between the operator's principal operations inspector (POI) and principal maintenance inspector (PMI). An operator that wishes to change aspects of its weight and balance control program, including average weights, should submit all applicable supporting data to the POI and PMI, as applicable, for approval. If the FAA approves the changes, the FAA will issue revised OpSpecs, MSpecs, or LOA, as appropriate.

402. Which portions of OpSpecs or MSpecs are relevant to an operator's weight and balance program?

a. This AC details methods to develop a weight and balance control program with greater accuracy and increased flexibility. By changing its OpSpecs or MSpecs, an operator may alter the weights used in its weight and balance control program to include appropriate combinations of standard average weights, average weights based on survey results, or actual weights.

b. Parts A and E of OpSpecs or MSpecs authorize an operator's weight and balance control program. These parts will address—

(1) Average passenger and bag weights;

(2) Situations when the use of average weights is inappropriate;

(3) The treatment of charter flights or special groups, if applicable;

(4) The type of loading schedule and instructions for its use;

(5) Aircraft weighing schedules; and

(6) Other procedures that the operator may require to assure control of weight and balance.

c. Paragraph E096 of the OpSpecs or MSpecs is issued to an operator with an approved aircraft fleet actual or average weight program. The FAA issues this paragraph after reviewing and approving an operator's weight and balance control program in its entirety.

d. Paragraph A011 of the OpSpecs or MSpecs is issued to an operator with an approved carry-on bag program. This paragraph provides details about the operator's approved carry-on bag program and states whether the operator has a carry-on bag program or a no-carry-on bag program. The FAA will issue this paragraph after reviewing the operator's carry-on baggage program in its entirety.

e. If an operator chooses to use standard average weights as outlined in this AC, the FAA will document that decision by issuing one or more of the following OpSpecs or MSpecs paragraphs. If an operator proposes to use different average weights (weights other than the standard average or segmented weights) and the FAA concurs with the statistically valid data provided by the operator to support such average weight differences, then those differences will be documented in the following OpSpecs or MSpecs. Although these paragraphs authorize an operator to use average and/or segmented weights, an operator may use actual weights at any time once issued these paragraphs.

(1) Paragraph A097—Small Cabin Aircraft Passenger and Baggage Weight Program.

(2) Paragraph A098—Medium Cabin Aircraft Passenger and Baggage Weight Program.

(3) Paragraph A099—Large Cabin Aircraft Passenger and Baggage Weight Program.

NOTE: If an operator does not provide the FAA with adequate information to justify the issuance of one of the above paragraphs that documents the use of standard average, survey-derived average, and/or segmented weights, the FAA may issue paragraph A096, requiring the operator to use actual weights for a specific aircraft or aircraft fleet.

f. If an operator chooses to develop a weight and balance control program using only actual weights for all the aircraft it operates, the FAA may issue OpSpec/MSpec paragraph A096. The FAA will not issue paragraphs A097, A098, or A099 to operators with a weight and balance control program that uses only actual weights. The FAA will only issue paragraphs A096, A097, A098, and/or A099 after reviewing the operator's actual or average weight program.

g. An operator that receives approval to use nonstandard average weights should document and make available, upon request, the data and methodology used to derive those weights. An operator's documentation should be sufficiently comprehensive to allow the FAA to reproduce the same results during an audit. An operator should retain this documentation for as long as the operator uses the nonstandard average weights in its weight and balance control program.

h. If an operator chooses to conduct a survey, the operator will use the results of the survey to establish a revised average weight and must curtail the loading envelope as necessary. However, if the survey results indicate the average weights are within 2 percent of the standard average weights outlined in this AC, the operator may elect to adopt the standard average weights only after submitting the survey results to the FAA and receiving approval through its OpSpecs, MSpecs, or LOA.

i. For operators using an onboard weight and balance system to determine the weight and balance of the aircraft, the FAA will issue OpSpecs or MSpecs paragraph A096. Paragraph A096 documents the use of actual weights and the use of its onboard weight and balance system. For an operator that chooses to use standard average weights as a backup system, the FAA will issues paragraphs A097, A098, or A099, as appropriate. By authorizing the use of average weights, the operator may elect to use actual weights derived from its onboard weight and balance system, and may use average weights as an alternative should the system be inoperative.

j. For operators of all-cargo aircraft, the FAA will issue OpSpecs or MSpecs paragraph A096. Paragraph A096 documents the use of actual weights, with the exception of flightcrew and flightcrew bag weights. These weights may be accounted for using the standard average weights described in Chapter 3, Table 3-3.

403. When will the FAA revise the standard average weights in this AC?

The FAA will periodically review the standard average passenger weights listed in this AC, after the release of a new NHANES. If the FAA finds that the data from NHANES indicates a weight change of more than 2 percent, the FAA will revise this AC to update the standard average weights.

/s/ John Allen for
James J. Ballough
Director, Flight Standards Service

APPENDIX 1. DEFINITIONS

1. **Basic empty weight.** The aircraft empty weight, adjusted for variations in standard items.

2. **Cargo.** As used in this advisory circular (AC), cargo refers to everything carried in the cargo compartments of the aircraft. This includes bags, mail, freight, express, and company material. It also includes live animals, dangerous goods, and hazardous materials as subcategories of the above.

3. **Carry-on bag.** A bag that the operator allows the passenger to carry onboard. It should be of a size and shape that will allow it to be stowed under the passenger seat or in a storage compartment. The operator establishes the exact dimensional limits based on the particular aircraft stowage limits.

4. **Certificated weight and CG limits.** Weight and center of gravity (CG) limits are established at the time of aircraft certification. They are specified in the applicable aircraft flight manual (AFM).

5. **Checked bags.** Checked bags are those bags placed in the cargo compartment of the aircraft. This includes bags that are too large to be placed in the cabin of the aircraft or those bags that are required to be carried in the cargo compartment by regulation, security program, or company policy. For bags checked plane-side, see the definition for plane-side loaded bags.

6. **Curtailment.** Creating an operational loading envelope that is more restrictive than the manufacturers' CG envelope, to assure the aircraft will be operated within limits during all phases of flight. Curtailment typically accounts for, but is not limited to, in-flight movement, gear and flap movement, cargo variation, fuel density, fuel burn-off, and seating variation.

7. **Fleet empty weight.** Average operational empty weight (OEW) used for a fleet or group of aircraft of the same model and configuration.

8. **Freight.** Cargo carried for hire in the cargo compartment that is not mail or passenger bags.

9. **Heavy bags.** For this AC, heavy bags are considered any bag that weighs more than 50 pounds but less than 100 pounds. Bags that are 100 pounds or more are considered freight.

10. **Large cabin aircraft.** Aircraft with a maximum type-certificated seating capacity of 71 or more passenger seats.

11. **Loading envelope.** Weight and CG envelope used in a loading schedule. Loading the aircraft within the loading envelope will maintain the aircraft weight and CG within the manufacturer's type-certificated limits throughout the flight.

12. **Loading schedule.** Method for calculating and documenting aircraft weight and balance prior to taxiing, to ensure the aircraft will remain within all required weight and balance limitations throughout the flight.

13. Manufacturer's empty weight. Weight of structure, powerplant, furnishings, systems, and other items of equipment that are an integral part of a particular aircraft configuration. (It is essentially a "dry" weight, including only those fluids contained in closed systems.)

14. Maximum landing weight. The maximum weight at which the aircraft may normally be landed.

15. Maximum takeoff weight. The maximum allowable aircraft weight at the start of the takeoff run.

16. Maximum taxi weight. The maximum allowable aircraft weight for taxiing.

17. Maximum zero-fuel weight. The maximum permissible weight of an aircraft with no disposable fuel and oil.

18. Medium cabin aircraft. Aircraft with a maximum type-certificated seating capacity between 70 and 30 passenger seats, inclusive.

19. Moment. A force that causes or tries to cause an object to rotate.

20. Onboard weight and balance system. A system that weighs an aircraft and payload, then computes the CG using equipment onboard the aircraft.

21. Operational empty weight (OEW). Basic empty weight or fleet empty weight plus operational items.

22. Operational items. Personnel, equipment, and supplies necessary for a particular operation but not included in basic empty weight. These items may vary for a particular aircraft and may include, but are not limited to, the following:

a. Crewmembers, supernumeraries, and bags;

b. Manuals and navigation equipment;

c. Passenger service equipment, including pillows, blankets, and magazines;

d. Removable service equipment for cabin, galley, and bar;

e. Food and beverage, including liquor;

f. Usable fluids, other than those in useful load;

g. Required emergency equipment for all flights;

h. Life rafts, life vests, and emergency transmitters;

i. Aircraft unit load devices;

j. Potable water;

k. Drainable unusable fuel;

l. Spare parts normally carried aboard and not accounted for as cargo; and

m. All other equipment considered standard by the operator.

23. Passenger assist/comfort animals and devices. These include, but are not limited to, canes, crutches, walkers, wheelchairs, medically-required animal comfort companions, or animals required to assist the vision impaired.

24. Passenger weight. Passenger weight is the actual weight or the approved average weight of the passenger.

a. An adult is defined as an individual 13 years or older.

b. A child is defined as an individual aged 2 to less than 13 years of age.

c. Infants are children who have not yet reached their second birthday and are considered part of the adult standard average and segmented passenger weight.

25. Personal item. Items the operator may allow a passenger to carry aboard, in addition to a carry-on bag. Typically, an operator may allow one personal item such as a purse, briefcase, computer and case, camera and case, diaper bag, or an item of similar size. Other items, such as coats, umbrellas, reading material, food for immediate consumption, infant restraining device, and passenger assist/comfort animals and devices, are allowed to be carried on the aircraft and are not counted against the personal item allowance.

26. Plane-side loaded bag. Any bag or item that is placed at the door or steps of an aircraft and subsequently placed in the aircraft cargo compartment or cargo bin.

27. Reference Balance Arm (BA). The horizontal distance from the reference datum to the CG of an item.

28. Segmented Weights. Passenger weights derived by adding a portion of the standard deviation to an average weight to increase the confidence that the actual weight will not exceed the average weight.

29. Small cabin aircraft. Aircraft with a maximum type-certificated seating capacity between 5 and 29 passenger seats, inclusive.

30. Standard basic empty weight. Manufacturer's empty weight plus standard items.

31. Standard items. Equipment and fluids not considered an integral part of a particular aircraft and not a variation for the same type of aircraft. These items may include, but are not limited to, the following:

a. Unusable fuel and other unusable fluids;

b. Engine oil;

c. Toilet fluid and chemical;

d. Fire extinguishers, pyrotechnics, and emergency oxygen equipment;

e. Structure in galley, buffet, and bar; and

f. Supplementary electronic equipment.

32. Useful Load. Difference between takeoff weight and OEW. It includes payload, usable fuel, and other usable fluids not included as operational items.

APPENDIX 2. SOURCE OF STANDARD AVERAGE WEIGHTS IN THIS AC

1. Standard average passenger weights.

a. The Federal Aviation Administration (FAA) examined data from several large-scale, national health studies conducted by U.S. Government health agencies. The FAA found that the National Health and Nutrition Examination Survey (NHANES), conducted by the Centers for Disease Control (CDC), provided the most comprehensive and appropriate data. The data in NHANES cover a broad spectrum of the general population, are based on a large sample size, and are not restricted geographically to a particular area.

b. The CDC collects NHANES data annually by conducting an actual scale weighing of approximately 9,000 subjects in a clinical setting. The standard deviation of the sample was 47 pounds. The CDC last published results from NHANES in 2000. Additional information on NHANES can be found at the following Web sites:

(1) General information.
http://www.cdc.gov/nchs/nhanes.htm

(2) Analytic and reporting guidelines.
http://www.cdc.gov/nchs/data/nhanes/nhanes3/nh3gui.pdf

(3) Data files for 1999–2000 survey.
http://www.cdc.gov/nchs/about/major/nhanes/NHANES99_00.htm

c. The FAA used most recent NHANES data set from surveys conducted in 1999 and 2000 to calculate the standard average passenger weights used in this advisory circular (AC). From this data set, the FAA separated out a separate data set of individuals who had not yet reached their 13th birthday to determine average child weight. From the remaining adult data set, the FAA removed all weight data that indicated the subject was clothed during the weighing and removed all data points more than two standard deviations from the mean. The FAA then calculated the average weights for males and females in the remaining data set.

2. Standard average bag weights.

To determine standard average weights for different types of bags, the FAA closely examined previous surveys conducted by operators, including several surveys conducted in response to FAA Notice 8400.40, Weight and Balance Control Programs for 10 to 19 Seat Airplanes Operated Under 14 CFR 121. The results of those surveys are summarized in Table 2-1.

TABLE 2-1. BAG SURVEY RESULTS

Item Surveyed	Average Weight	Standard Deviation
Personal items and carry-on bags	15.1 lb	8.2 lb
Checked bags	28.9 lb	10.8 lb
Heavy bags	58.7 lb	7.2 lb

APPENDIX 3. SAMPLE OPERATIONAL LOADING ENVELOPE

1. Introduction.

The following is an example of how to develop an operational loading envelope. For this example, a hypothetical 19-seat commuter category aircraft is used. Although this example uses inches to measure fuselage station, an operator may choose to use an index system for convenience.

2. Assumptions for this example.

a. Passenger weight. Because the aircraft is certificated under the commuter category of Title 14 of the Code of Federal Regulations (14 CFR) part 23 and because it is originally type-certificated for 5 or more passenger seats, it would be appropriate to use the average weights listed in Chapter 3, Section 2. For this example, it is assumed that the operator does not have a carry-on bag program. Therefore, the operator should use a standard average passenger weight of 189 pounds in winter and 184 pounds in summer. For this example, a standard average passenger weight of 189 pounds is used. The operator also assumes that passengers are distributed throughout the cabin in accordance with the window-aisle-remaining method. Note that because this aircraft has only two window seats per row, the operator may reasonably assume that passengers begin seating themselves in the front of the cabin and select the most forward seat available.

b. Bag weights. For this example, the operator assumes that a checked bag weighs 30 pounds and a plane-side loaded bag weighs 20 pounds.

c. Interior seating. For this example, consider a commuter category 19-seat aircraft with the interior seating diagram shown in Figure 3-1.

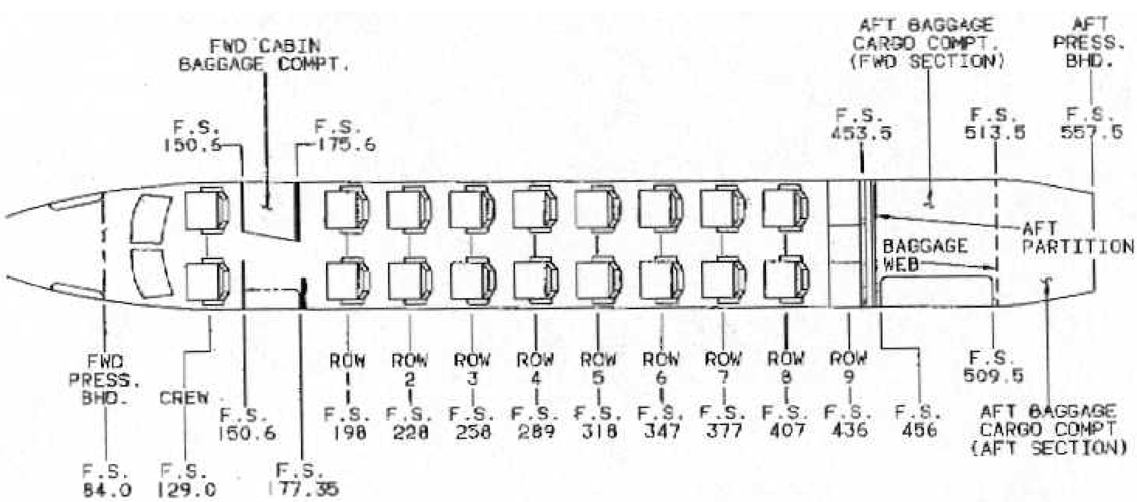


FIGURE 3-1. SAMPLE AIRCRAFT INTERIOR SEATING DIAGRAM

(Diagram courtesy of Raytheon Aircraft Company)

3. Curtailments for passenger seating variation.

a. Establishing zones. The operator elects to separate the passenger cabin into three zones. Zone 1 will contain rows 1 to 3, zone 2 will contain rows 4 to 6, and zone 3 will contain rows 7 to 9.

b. Determining the centroid of each zone. When using cabin zones, an operator assumes that all passengers are sitting at the centroid of their zone. To find the centroid of each zone—

(1) Multiply the number of seats in each row of the zone by the location of the row,

(2) Add each number calculated in step 1, and

(3) Divide the number in step 2 by the total number of seats in the zone.

NOTE: For this sample aircraft, see Tables 3-1 through 3-3 below.

TABLE 3-1. CALCULATION OF ZONE 1 CENTROID

Row No.	No. of Seats	Row Location	No. of Seats × Row Location
1	2	198 in	396 in
2	2	228 in	456 in
3	2	258 in	516 in
TOTAL	6	NA	1,368 in
1,368 in / 6 seats = 228 in			

TABLE 3-2. CALCULATION OF ZONE 2 CENTROID

Row No.	No. of Seats	Row Location	No. of Seats × Row Location
4	2	289 in	578 in
5	2	318 in	636 in
6	2	347 in	694 in
TOTAL	6	NA	1,908 in
1,908 in / 6 seats = 318 in			

TABLE 3-3. CALCULATION OF ZONE 3 CENTROID

Row No.	No. of Seats	Row Location	No. of Seats × Row Location
7	2	377 in	754 in
8	2	407 in	814 in
9	3	436 in	1,308 in
TOTAL	7	NA	2,876 in

2,876 in / 7 seats = 411 in

c. Comparing loading assumptions. To determine the appropriate amount of curtailment, the operator should compare aircraft loading based on the window-aisle-remaining assumption with aircraft loaded based on the assumption that passengers are sitting at the centroid of their respective zones. An operator may determine the appropriate curtailment by comparing the moments resulting from these assumptions and identifying the loading scenarios that result in the most forward or aft center of gravity (CG) location. See Tables 3-4 through 3-12 below.

(1) Curtailment calculation for zone 1.

TABLE 3-4. MOMENTS RESULTING FROM THE ZONE CENTROID ASSUMPTION FOR ZONE 1

Passenger No.	Assumed Weight	Assumed Arm	Moment	Cumulative Moment
1	189 lb	228 in	43,092 in-lb	43,092 in-lb
2	189 lb	228 in	43,092 in-lb	86,184 in-lb
3	189 lb	228 in	43,092 in-lb	129,276 in-lb
4	189 lb	228 in	43,092 in-lb	172,368 in-lb
5	189 lb	228 in	43,092 in-lb	215,460 in-lb
6	189 lb	228 in	43,092 in-lb	258,552 in-lb

TABLE 3-5. MOMENTS RESULTING FROM THE WINDOW-AISLE-REMAINING ASSUMPTION FOR ZONE 1

Passenger No.	Assumed Row	Weight	Arm	Moment	Cumulative Moment
1	1	189 lb	198 in	37,422 in-lb	37,422 in-lb
2	1	189 lb	198 in	37,422 in-lb	74,844 in-lb
3	2	189 lb	228 in	43,092 in-lb	117,936 in-lb
4	2	189 lb	228 in	43,092 in-lb	161,028 in-lb
5	3	189 lb	258 in	48,762 in-lb	209,790 in-lb
6	3	189 lb	258 in	48,762 in-lb	258,552 in-lb

TABLE 3-6. COMPARISON OF MOMENTS FOR ZONE 1

Passenger No.	Cumulative Moment From the Zone Centroid Assumption	Cumulative Moment From the Window-Aisle-Remaining Assumption	Difference
1	43,092 in-lb	37,422 in-lb	-5,670 in-lb
2	86,184 in-lb	74,844 in-lb	-11,340 in-lb
3	129,276 in-lb	117,936 in-lb	-11,340 in-lb
4	172,368 in-lb	161,028 in-lb	-11,340 in-lb
5	215,460 in-lb	209,790 in-lb	-5,670 in-lb
6	258,552 in-lb	258,552 in-lb	0 in-lb

(2) Curtailment calculation for zone 2.

TABLE 3-7. MOMENTS RESULTING FROM THE ZONE CENTROID ASSUMPTION FOR ZONE 2

Passenger No.	Assumed Weight	Assumed Arm	Moment	Cumulative Moment
7	189 lb	318 in	60,102 in-lb	60,102 in-lb
8	189 lb	318 in	60,102 in-lb	120,204 in-lb
9	189 lb	318 in	60,102 in-lb	180,306 in-lb
10	189 lb	318 in	60,102 in-lb	240,408 in-lb
11	189 lb	318 in	60,102 in-lb	300,510 in-lb
12	189 lb	318 in	60,102 in-lb	360,612 in-lb

TABLE 3-8. MOMENTS RESULTING FROM THE WINDOW-AISLE-REMAINING ASSUMPTION FOR ZONE 2

Passenger No.	Assumed Row	Weight	Arm	Moment	Cumulative Moment
7	4	189 lb	289 in	54,621 in-lb	54,621 in-lb
8	4	189 lb	289 in	54,621 in-lb	109,242 in-lb
9	5	189 lb	318 in	60,102 in-lb	169,344 in-lb
10	5	189 lb	318 in	60,102 in-lb	229,446 in-lb
11	6	189 lb	347 in	65,583 in-lb	295,029 in-lb
12	6	189 lb	347 in	65,583 in-lb	360,612 in-lb

TABLE 3-9. COMPARISON OF MOMENTS FOR ZONE 2

Passenger No.	Cumulative Moment From the Zone Centroid Assumption	Cumulative Moment From the Window-Aisle-Remaining Assumption	Difference
7	60,102 in-lb	54,621 in-lb	-5,481 in-lb
8	120,204 in-lb	109,242 in-lb	-10,962 in-lb
9	180,306 in-lb	169,344 in-lb	-10,962 in-lb
10	240,408 in-lb	229,446 in-lb	-10,962 in-lb
11	300,510 in-lb	295,029 in-lb	-5,481 in-lb
12	360,612 in-lb	360,612 in-lb	0 in-lb

(3) Curtailment calculation for zone 3.

TABLE 3-10. MOMENTS RESULTING FROM THE ZONE CENTROID ASSUMPTION FOR ZONE 3

Passenger No.	Assumed Weight	Assumed Arm	Moment	Cumulative Moment
13	189 lb	411 in	77,679 in-lb	77,679 in-lb
14	189 lb	411 in	77,679 in-lb	155,358 in-lb
15	189 lb	411 in	77,679 in-lb	233,037 in-lb
16	189 lb	411 in	77,679 in-lb	310,716 in-lb
17	189 lb	411 in	77,679 in-lb	388,395 in-lb
18	189 lb	411 in	77,679 in-lb	466,074 in-lb
19	189 lb	411 in	77,679 in-lb	543,753 in-lb

TABLE 3-11. MOMENTS RESULTING FROM THE WINDOW-AISLE-REMAINING ASSUMPTION FOR ZONE 3

Passenger No.	Assumed Row	Weight	Arm	Moment	Cumulative Moment
13	7	189 lb	377 in	71,253 in-lb	71,253 in-lb
14	7	189 lb	377 in	71,253 in-lb	142,506 in-lb
15	8	189 lb	407 in	76,923 in-lb	219,429 in-lb
16	8	189 lb	407 in	76,923 in-lb	296,352 in-lb
17	9	189 lb	436 in	82,404 in-lb	378,756 in-lb
18	9	189 lb	436 in	82,404 in-lb	461,160 in-lb
19	9	189 lb	436 in	82,404 in-lb	543,564 in-lb

TABLE 3-12. COMPARISON OF MOMENTS FOR ZONE 3

Passenger No.	Cumulative Moment From the Zone Centroid Assumption	Cumulative Moment From the Window-Aisle-Remaining Assumption	Difference
13	77,679 in-lb	71,253 in-lb	-6,426 in-lb
14	155,358 in-lb	142,506 in-lb	-12,852 in-lb
15	233,037 in-lb	219,429 in-lb	-13,608 in-lb
16	310,716 in-lb	296,352 in-lb	-14,364 in-lb
17	388,395 in-lb	378,756 in-lb	-9,639 in-lb
18	466,074 in-lb	461,160 in-lb	-4,914 in-lb
19	543,753 in-lb	543,564 in-lb	-189 in-lb

(4) Determining the most adverse loading. It is important that an operator examine the above results for each zone and determine which loading scenario results in the greatest difference in moments. For zones 1 and 2, having two, three, or four passengers in the zone results in the largest difference between the moments. For zone 3, having four passengers in the zone results in the largest difference. In this case, the operator should curtail the manufacturer's loading envelope forward and aft by the sum of these moments, 36,666 inch-pounds, to account for the potential variation in passenger seating. In this example, the 36,666 inch-pounds is the sum of 11,340 from Table 3-6; 10,962 from Table 3-9; and 14,364 from Table 3-12.

(5) Using actual seating location. Alternatively, an operator may reasonably avoid the above curtailment calculations by determining the actual seating location of each passenger in the cabin. By eliminating potential variation in passenger seating, an operator would not need to make assumptions about passenger seating and would not need to curtail the loading envelope accordingly. An operator choosing to use actual seating location should have procedures in place to ensure that passengers sit in their assigned location.

4. Other curtailments to the manufacturer's loading envelope.

a. Variation in passenger weight. Because the operator in this example elects to use standard average weights on a small-cabin aircraft, an additional curtailment for potential variation in passenger weight is required. The operator should curtail the manufacturer's loading envelope by 23,791 inch-pounds forward and aft to account for the variation in passenger weight. A full explanation of this calculation is contained in Appendix 4.

b. Variation in fuel density. Because the loading of fuel does not significantly change the CG of the aircraft, the operator would not need to provide a curtailment for variation in fuel density.

c. Fuel movement in flight. For this sample aircraft, the manufacturer has considered the movement of fuel in flight. Therefore, the operator does not need to include additional curtailments in the operational loading envelope.

d. Fluids. The sample aircraft does not have a lavatory or catering.

e. Bags and freight. The sample aircraft has an aft bag compartment split into two sections. If the operator has procedures in place to restrict the movement of bags between the two sections, no additional curtailment to the envelope is required.

f. In-flight movement of passengers and crewmembers. Because there are no flight attendants and the aircraft is not equipped with a lavatory, it is reasonable to assume that passengers or crewmembers will not move about the cabin in flight.

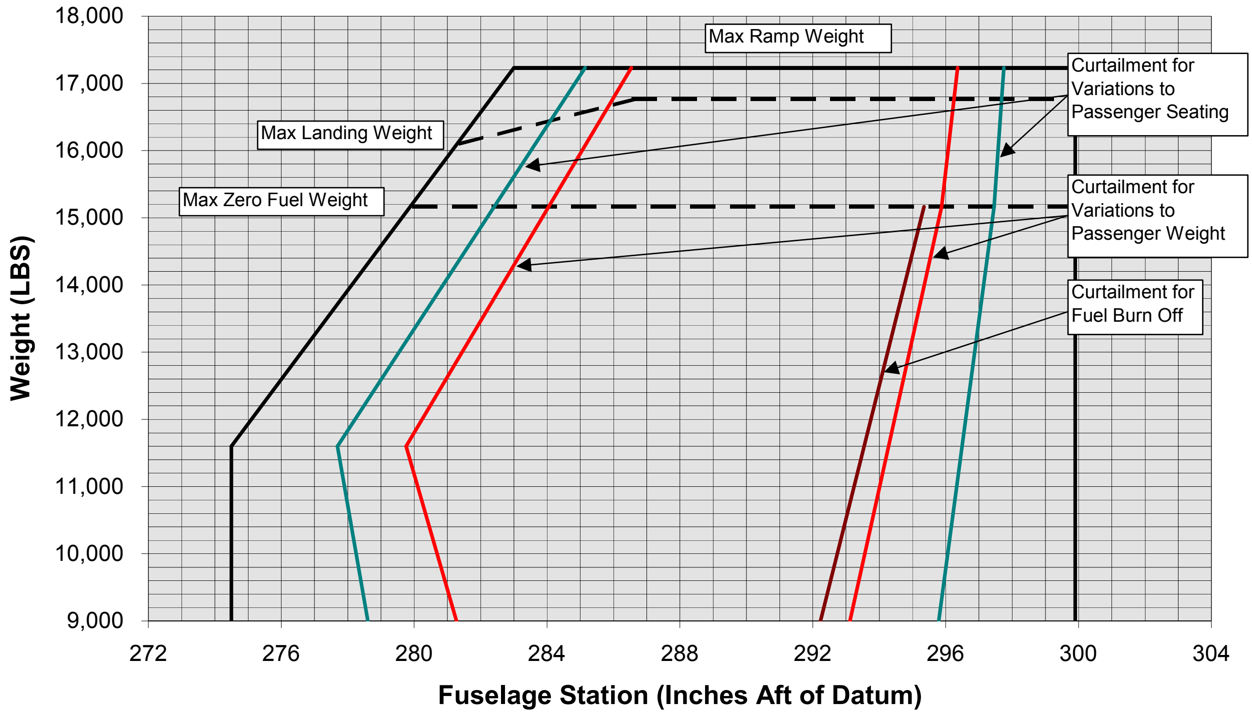
g. Movement of flaps and landing gear. The manufacturer of the sample aircraft has considered the movement of flaps and landing gear in the development of its loading envelope. The operator does not need to include any additional curtailments in its operational loading envelope for the movement of those items.

h. Fuel consumption. To ensure the sample aircraft remains within the manufacturer's CG limits as fuel is consumed, the operator should curtail the aft CG at weights less than the zero-fuel weight by 8,900 inch-pounds. In this example, the 8,900 inch-pounds is the fuel burn deviation that would bring the aircraft outside the aft CG limit during the course of flight.

5. Operational loading envelope diagrams.

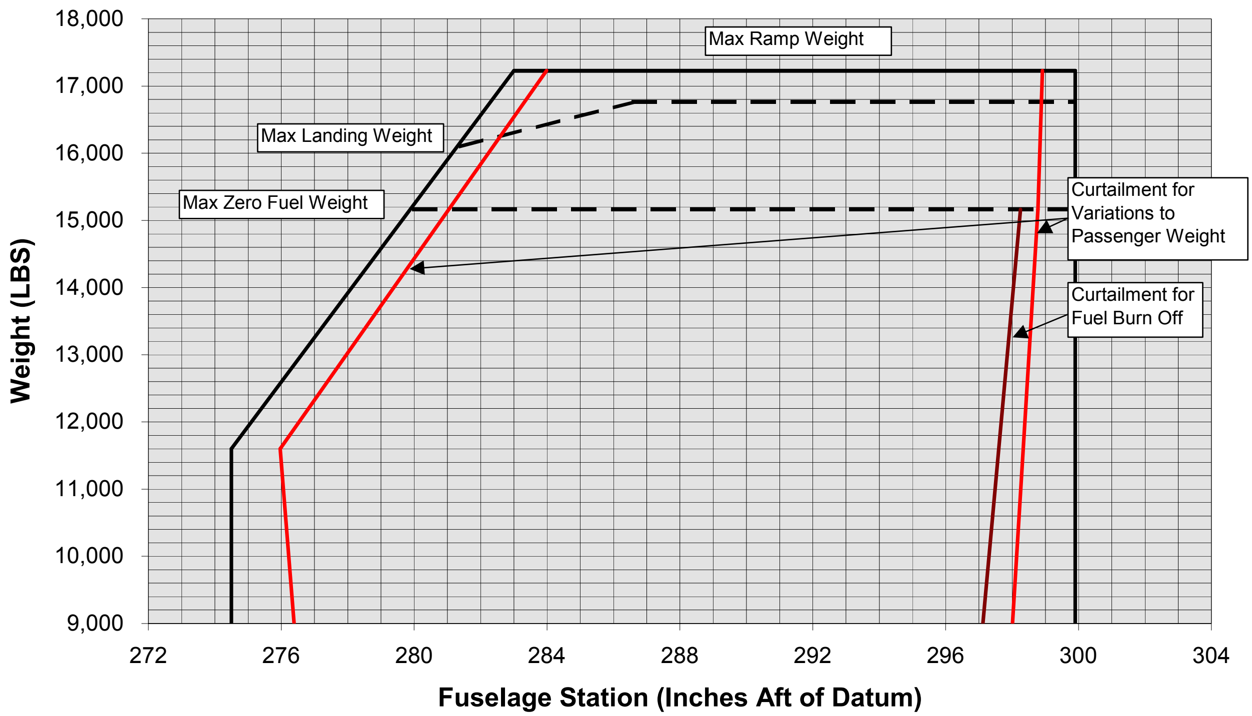
a. Figure 3-2 below shows the operator's curtailments to the manufacturer's loading envelope, based on the assumptions made about variations in passenger seating and weight, as well as fuel consumption.

FIGURE 3-2. OPERATIONAL LOADING ENVELOPE WITH A CURTAILMENT FOR VARIATIONS IN PASSENGER SEATING



b. To expand the operational loading envelope, an operator could choose to use the actual seating location of passengers in the cabin and eliminate the curtailment for variations in passenger seating. Figure 3-3 below shows the expansion of the operational loading envelope.

FIGURE 3-3. OPERATIONAL LOADING ENVELOPE USING ACTUAL SEATING LOCATION OF PASSENGERS



APPENDIX 4. ADDITIONAL CURTAILMENTS TO CG ENVELOPES TO ACCOUNT FOR VARIATIONS TO PASSENGER WEIGHTS

a. The use of average weights for small cabin aircraft requires consideration of an additional curtailment to the center of gravity (CG) envelope for passenger weight variations and male/female passenger ratio. This curtailment is in addition to the standard curtailments discussed in Chapter 2.

(1) Passenger weight variation is determined by multiplying the standard deviation (from the source of the average passenger weight used) by the row factor from Table 4-1. The following table ensures a 95-percent confidence level of passenger weight variation, using the window-aisle-remaining seating method.

TABLE 4-1. ROW FACTOR

No. of Rows	2-abreast	3-abreast	4-abreast
2	2.96	2.73	2.63
3	2.41	2.31	2.26
4	2.15	2.09	2.06
5	2.00	1.95	1.93
6	1.89	1.86	1.84
7	1.81	1.79	1.77
8	1.78	1.73	1.69
9	1.70	1.68	1.65
10	1.66	1.65	1.62
11	1.63	1.59	1.59
12	1.60	1.57	1.57
13	1.57	1.54	1.54
14	1.55	1.52	1.52
15	1.53	1.51	1.51
16	1.49	1.49	1.49
17	1.48	1.48	1.48
18	1.46	1.46	1.46

(2) Protect against the possibility of an all-male flight by subtracting the difference between the male and average passenger weight.

(3) The sum of these two provides an additional weight to be used for CG curtailment, similar to the way in which passenger seating variation is calculated.

b. If the operator chooses to use the passenger cabin zone concept (as described in Appendix 3) and apply this concept to account for variation in passenger weight, then the row factor in Table 4-1 corresponding to the number of rows in each zone should be used. For the purposes of this curtailment, the zone can be no smaller than two rows, if row count is used for passenger seating calculations. Therefore, if an operator chooses to use row count, the operator must use the row factor for two rows.

c. Calculation of the curtailment passenger weight variation is decided by multiplying the standard deviation by the correction factor and adding the difference between male and female passenger weight. For example, assuming a 47 pound standard deviation, the difference between the average passenger weight and an all-male weight is 10 pounds (from 1999–2000 National Health and Nutrition Examination Survey (NHANES) data), and a sample aircraft with 9 rows in a 2-abreast configuration. The additional weight to be curtailed is determined as:

$$\text{Weight for Additional Curtailment} = (47 \times 1.70) + (10) = 90 \text{ lbs}$$

d. For the example, the additional curtailment should be accomplished by assuming passenger loading at 90 pounds using the program method for passenger seating variation (e.g., window-aisle-remaining). Using the window-aisle-remaining method, the additional curtailment in the example is determined to be 62,310 inch-pounds forward and aft. Table 4-2 displays the calculations used in this example.

NOTE: The following definitions describe the parameters used in the sample:

- Seat Centroid: Location of passenger weight at seat
- Seat Moment: Additional passenger weight × seat centroid
- Total Weight: Sum of additional passenger weights (running total)
- Total Moment: Sum of additional passenger moments
- Moment Deviation: Difference between total moment and moment generated by assuming additional passenger weight is located at the cabin centroid (323.8 in)

TABLE 4-2. SAMPLE CURTAILMENT DUE TO VARIATIONS IN PASSENGER WEIGHT AND MALE/FEMALE RATIO USING WINDOW-AISLE METHOD

Coach Class (Y) Cabin Centroid 323.8

Passenger Weight: 95

Forward Seating					Aft Seating				
Seat Centroid	Seat Moment	Total Weight	Total Moment	Moment Deviation	Seat Centroid	Seat Moment	Total Weight	Total Moment	Moment Deviation
198.0	18,810	95	18,810	-11,950	436.0	41,420	95	41,420	10,660
198.0	18,810	190	37,620	-23,900	436.0	41,420	190	82,840	21,320
228.0	21,660	285	59,280	-33,000	436.0	41,420	285	124,260	31,980
228.0	21,660	380	80,940	-42,100	407.0	38,665	380	162,925	39,885
258.0	24,510	475	105,450	-48,350	407.0	38,665	475	201,590	47,790
258.0	24,510	570	129,960	-54,600	377.0	35,815	570	237,405	52,845
289.0	27,455	665	157,415	-57,905	377.0	35,815	665	273,220	57,900
289.0	27,455	760	184,870	-61,210	347.0	32,965	760	306,185	60,105
318.0	30,210	855	215,080	-61,760	347.0	32,965	855	339,150	62,310
318.0	30,210	950	245,290	-62,310	318.0	30,210	950	369,360	61,760
347.0	32,965	1,045	278,255	-60,105	318.0	30,210	1,045	399,570	61,210
347.0	32,965	1,140	311,220	-57,900	289.0	27,455	1,140	427,025	57,905
377.0	35,815	1,235	347,035	-52,845	289.0	27,455	1,235	454,480	54,600
377.0	35,815	1,330	382,850	-47,790	258.0	24,510	1,330	478,990	48,350
407.0	38,665	1,425	421,515	-39,885	258.0	24,510	1,425	503,500	42,100
407.0	38,665	1,520	460,180	-31,980	228.0	21,660	1,520	525,160	33,000
436.0	41,420	1,615	501,600	-21,320	228.0	21,660	1,615	546,820	23,900
436.0	41,420	1,710	543,020	-10,660	198.0	18,810	1,710	565,630	11,950
436.0	41,420	1,805	584,440	0	198.0	18,810	1,805	584,440	0
				-6.2					6.2

APPENDIX 5. OPTIONS TO IMPROVE ACCURACY

A number of options are available that enable operators to deviate from standard assumed weights and may also provide relief from constraints required when assumed averages are used. These options include:

(1) Surveys. Surveys may be accomplished for passenger weights (to include carry-on bags), checked baggage weights, male/female ratios and fuel densities. These surveys may be conducted for entire operator route systems, or by specific market or region. Surveys practices and data reduction must conform to the requirements defined in this advisory circular (AC). Use of surveys may allow an operator to use passenger and baggage weights less than the standard specified in this AC. Also, a survey may find that the assumed male/female ratio is incorrect and appropriate adjustments must be made. For example, let's assume the following results from an approved passenger and baggage survey.

Male passenger weight (M) = 183.3 pounds
Female passenger weight (F) = 135.8 pounds
Difference between male and average passenger weights = 24.0 pounds
Standard deviation of total sample (Sigma) = 47.6 pounds
Male/female ratio (Pax Ratio) = 50.6 percent
Checked baggage weight = 29.2 pounds
Baggage checked plane-side = 21.3 pounds
Carry-on and personal items weight (CO Wt) = 10.4 pounds
Carry-on and personal items per passenger ratio (CO Ratio) = 0.82 pounds
Survey conducted in summer months

The resulting assumed passenger weight for loading is expressed as:

$$\text{Passenger Weight} = M \times \text{Pax Ratio} + F \times (1 - \text{Pax Ratio}) + \text{CO Wt} \times \text{CO Ratio}$$

And is determined as:

$$\text{Summer Passenger Weight} = 0.506 \times 183.3 + (1 - 0.506) \times 135.8 + 10.4 \times 0.82 = 169 \text{ lb}$$
$$\text{Winter Passenger Weight} = 169 + 5 = 174 \text{ lb}$$

Survey results would also be used to determine the additional curtailment for variations to passenger weight. Assuming a 19-seat aircraft in 2-abreast configuration in our example, the additional weight to be curtailed would be:

$$\text{Additional Weight for Curtailment} = (47.6 \times 1.70) + 24 = 104.9 \text{ lb}$$

Also in our example, the assumed checked baggage weight is 30 pounds. Plane-side loaded bags would be assumed to weigh 20 pounds. (These weights are the standard average weights provided for a no-carry-on baggage program as described in Chapter 3, Section 2).

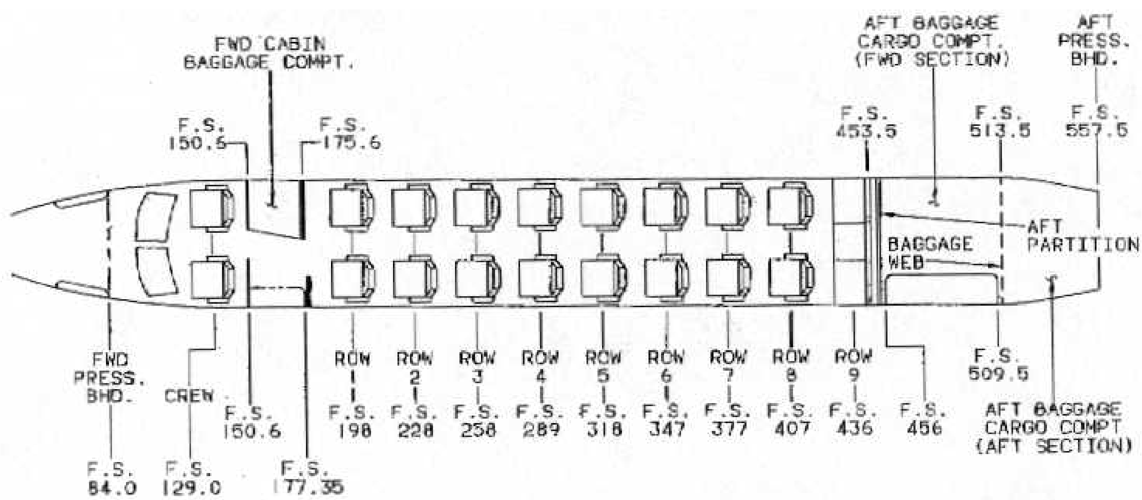
(2) Actual Weights. It is permissible to use actual weights in lieu of standard average, segmented, or survey-derived average weights (if applicable). Parameters that may use actual weights include passenger weights, checked baggage weights, carry-on bag weights, crew weights, and fuel density/weight.

(3) Passenger Cabin Zones and Row Count. Passenger cabins may be split up into zones provided an acceptable procedure for determination of passenger seating is included (e.g., use of seat assignments or crew counts seated passengers by zone). If zones are used, it may be reasonable for the operator to reduce the center of gravity (CG) passenger seating curtailment suggested in this AC by accommodating variations within each individual zone separately and totaling the results. Passenger row count allows the operator to eliminate the seating variation by accounting for where the passenger is actually seated.

An example of use of passenger zones follows.

Assume an aircraft interior as displayed in Figure 5-1.

FIGURE 5-1. SAMPLE AIRCRAFT INTERIOR SEATING DIAGRAM



(Diagram courtesy of Raytheon Aircraft Company)

Assume that for weight and balance purposes, it is desirable to break the cabin up into three passenger zones. The passenger zones will be determined as zone 1 (rows 1−3), zone 2 (rows 4−6), and zone 3 (rows 7−9). Use of the window-aisle-remaining method will be used in each zone to provide a total curtailment to the CG envelope. (For this sample aircraft, window-aisle-remaining method simply becomes forward and aft end loading). For each zone, a zone centroid must be calculated by counting the total number of seats and averaging their location.

Zone 1 centroid = (2 × 198.0 + 2 × 228.0 + 2 × 258.0) / (2 + 2 + 2) = 228.0 in.
Zone 2 centroid = (2 × 289.0 + 2 × 318.0 + 2 × 347.0) / (2 + 2 + 2) = 318.0 in.
Zone 3 centroid = (2 × 377.0 + 2 × 407.0 + 3 × 436.0) / (2 + 2 + 3) = 410.9 in.

Assuming the standard winter passenger weight of 195 pounds is used for the curtailment, the calculation of total moment is required for comparison to moment assuming each passenger is seated at the centroid of each passenger zone. The total moment is found by summing the individual moments calculated at each occupied seat in the window-aisle-remaining progression.

Forward Curtailment Calculations—ZONE 1

Pax	Row	Arm	Total Moment	Zone Centroid	Zone Moment	Delta Moment
1	1	198.0	38,610	228.0	44,460	-5,850
2	1	198.0	77,220	228.0	88,920	-11,700
3	2	228.0	121,680	228.0	133,380	-11,700
4	2	228.0	166,140	228.0	177,840	-11,700
5	3	258.0	216,450	228.0	222,300	-5,850
6	3	258.0	266,760	228.0	266,760	0

Forward Curtailment Calculations—ZONE 2

Pax	Row	Arm	Total Moment	Zone Centroid	Zone Moment	Delta Moment
1	4	289.0	56,355	318.0	62,010	-5,655
2	4	289.0	112,710	318.0	124,020	-11,310
3	5	318.0	174,720	318.0	186,030	-11,310
4	5	318.0	236,730	318.0	248,040	-11,310
5	6	347.0	304,395	318.0	310,050	-5,655
6	6	347.0	372,060	318.0	372,060	0

Forward Curtailment Calculations—ZONE 3

Pax	Row	Arm	Total Moment	Zone Centroid	Zone Moment	Delta Moment
1	7	377.0	73,515	410.9	80,117	-6,602
2	7	377.0	147,030	410.9	160,234	-13,204
3	8	407.0	226,395	410.9	240,351	-13,956
4	8	407.0	305,760	410.9	320,469	-14,709
5	9	436.0	390,780	410.9	400,586	-9,806
6	9	436.0	475,800	410.9	480,703	-4,903
7	9	436.0	560,820	410.9	560,820	0

The curtailment for passenger seating variation is determined by adding the largest delta moments from each of the passenger zones. In our example, the curtailment to the forward CG limit for passenger seating variation is -37,719 inch-pounds (-11,700 + -11,310 + -14,709). Similarly, curtailment to the aft limit of the CG envelope using window-aisle-remaining method loading from the most aft seat row moving forward (in each zone) would result in an adjustment of 37,719 inch-pounds. Figures 5-2 through 5-4 graphically show the curtailments for each passenger zone through use of forward and aft end loading using our example.

FIGURE 5-2. SAMPLE PASSENGER SEATING MOMENT

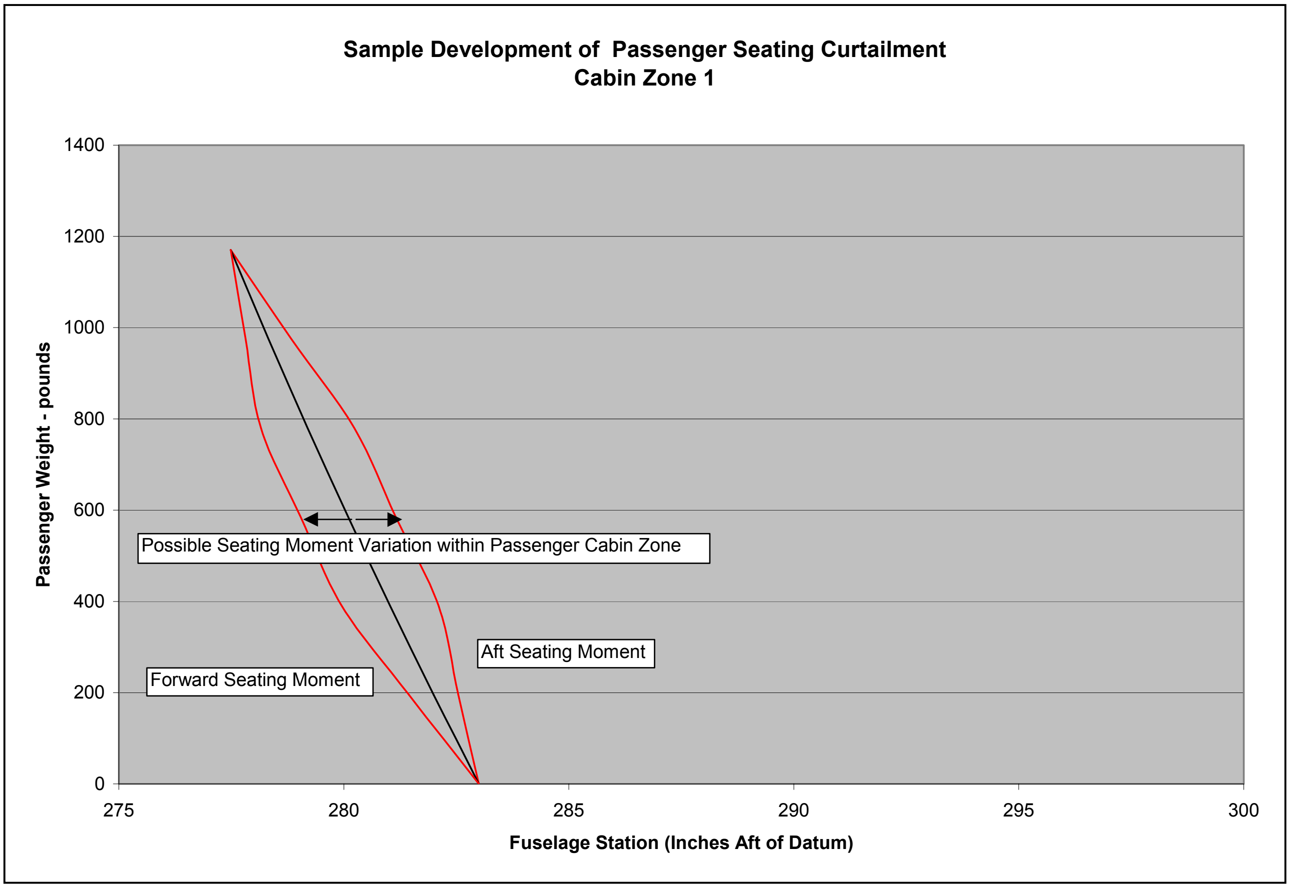


FIGURE 5-3. SAMPLE PASSENGER SEATING MOMENT

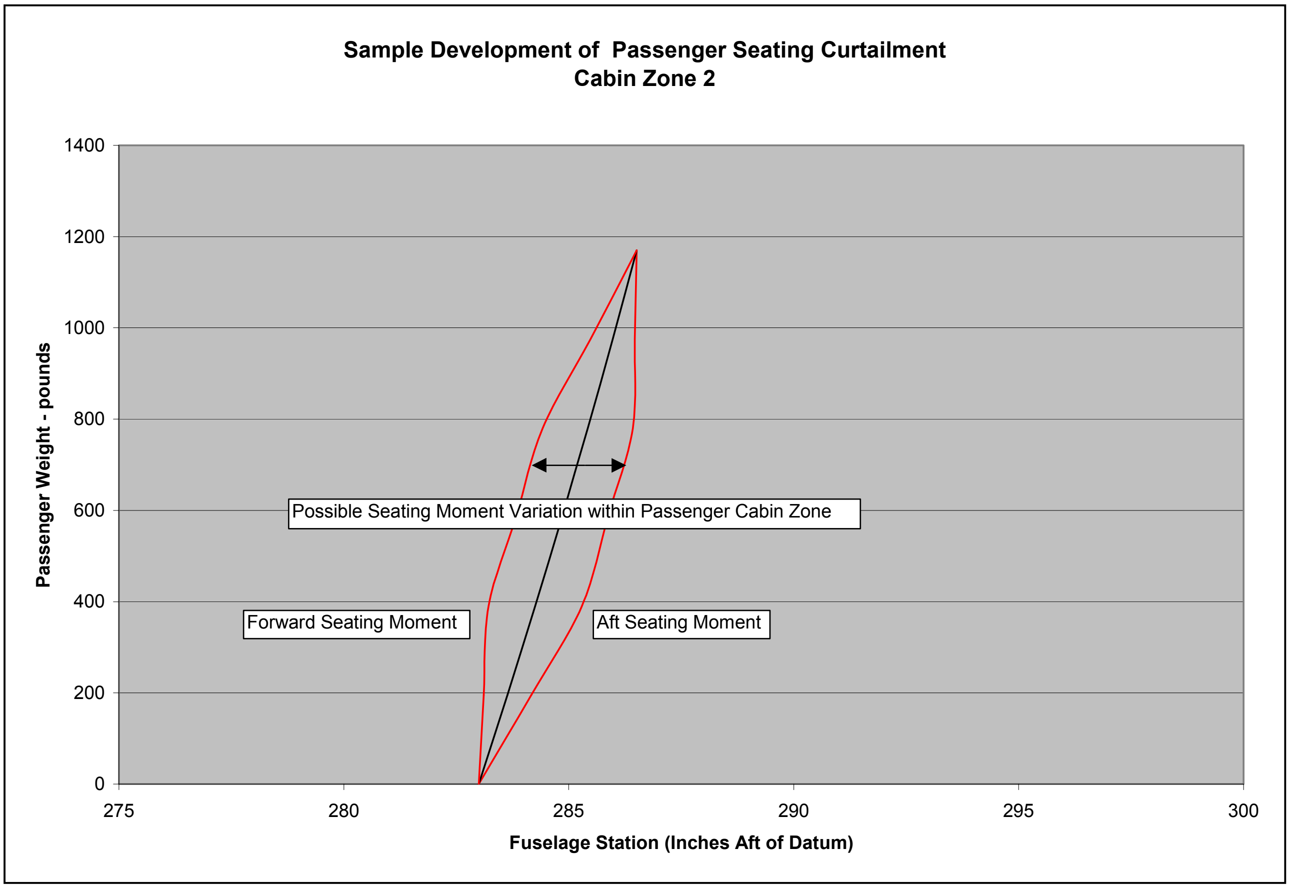
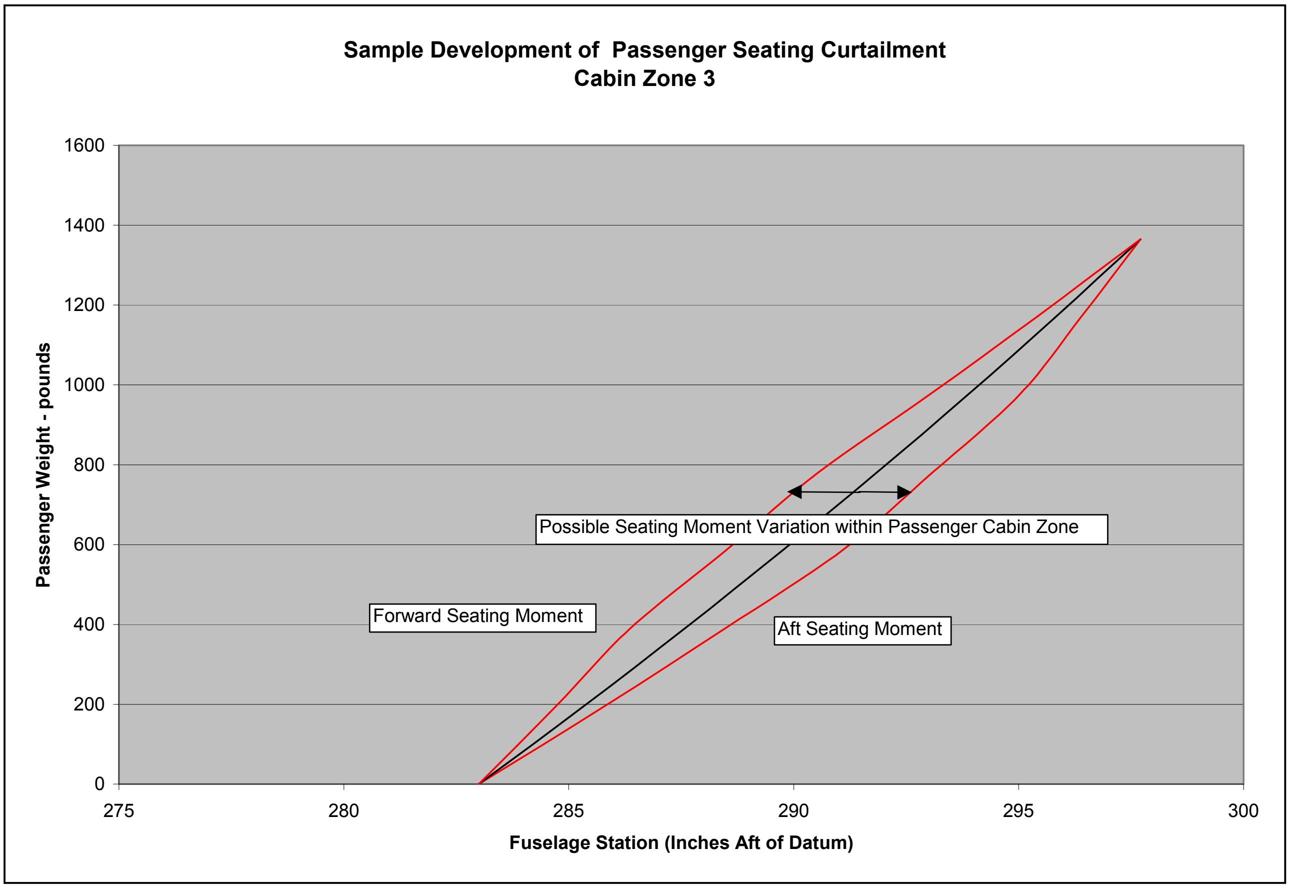


FIGURE 5-4. SAMPLE PASSENGER SEATING MOMENT



(4) Actual M/F Counts. Loading systems may use separate male and female assumed passenger weights for each operation. If the operator's weight and balance program is approved for use of male/female weights, then the operator must count the number of male passengers and female passengers separately. The male and female weights used may be from the development of standard passenger weight as described in this AC or they may be determined through an operator-developed survey as also described in this AC. Use of male/female weights may be for entire operations or for a particular route and/or region of flying.

An example of how male/female ratios can be applied to weight and balance systems follows.

Assuming the operator is using the survey results as described in subparagraph (1) above, the assumed male and female passenger weights, including average carry-on baggage, are computed as:

Male passenger weight (summer) = $183.3 + 10.4 \times 0.82 = 192$ lb
Male passenger weight (winter) = $192 + 5 = 197$ lb

Female passenger weight (summer) = $135.8 + 10.4 \times 0.82 = 144$ lb
Female passenger weight (winter) = $144 + 5 = 149$ lb

The weight and balance manifest would provide for identification of male/female identification and the passenger weights would be summed accordingly. For instance, 7 male and 11 female passengers would result in a total passenger weight of $(7 \times 192) + (11 \times 144) = 2{,}928$ pounds.

(5) Adolescent (Child) Weights. In most circumstances, an operator may consider any passenger less than 13 years of age, who is occupying a seat, to weigh less than an adult passenger as described in this AC. The standard adolescent child weights can be found in Table 3-1 of Chapter 3.

(6) Standard Weights with Approved No-Carry-on Baggage Program.

Summer Passenger Weight = 184 lb
Winter Passenger Weight = 189 lb
Checked Baggage Weight = 30 lb each
Baggage Checked Plane-side = 20 lb each

Inclusion in the no-carry-on baggage program does not preclude use of actual or surveyed weights for passengers, carry-on/personal items, checked baggage, or baggage checked plane-side.

(7) Automation. Automation may also be used to provide a more accurate weight and balance program. Examples of automation include use of seat assignments for the determination of passenger moment and historical seating to determine passenger moment.

APPENDIX 6. SAMPLE CG ENVELOPE DEVELOPMENT

Outlined below is an example of the development of a center of gravity (CG) envelope construction for a 19-seat commuter category aircraft. The sample system uses a CG diagram displayed in inches. Operators' systems may use a variety of methods to display CG diagram, including an Index system detailed in Chapter 2, Section 2 and in Appendix 3.

Sample Development of Weight and Balance System for 19-Seat Aircraft

a. CG Envelope Construction. The certified CG envelope provided by the manufacturer must be examined for the following curtailments.

(1) Variations to Passenger Seating (Outlined in Chapter 2). In this example, the window-aisle-remaining method was used considering a passenger weight of 189 pounds and using 3 passenger zones, where zone 1 is defined as rows 1–3, zone 2 is defined as rows 4–6, and zone 3 is defined as rows 7–9. (189 lb/pax is used since the operator will be using a no-carry-on baggage program as detailed later on in this sample exercise). The resulting curtailment for use of 3 passenger zones is 36,600 inch-pounds forward and aft.

(2) Variations to Passenger Weight (Outlined in Appendix 4). Since the sample aircraft falls into the group of aircraft requiring full evaluation of small cabin aircraft rules, application of a curtailment due to variations to passenger weight is required.

(a) Use of Passenger Zone Concept for Curtailment. Considering three cabin zones with each zone containing three rows in a 2-abreast configuration, the required row factor (see Appendix 4, Table 4-1) is 2.41. The row factor is multiplied by the standard deviation and the difference between average male and average female weights is added to provide the additional weight consideration. In our example, the standard deviation is calculated from the National Health and Nutrition Examination Survey (NHANES) data as 47 pounds, and the difference between average all-male and average passenger weights is 10 pounds. The resulting additional weight for curtailment is $47 \times 2.41 + 10 = 123$ pounds. This additional weight is applied per the window-aisle-remaining concept for each cabin zone independently and the results are summed to determine the amount of curtailment. In this case, the curtailment is found to be 23,791 inch-pounds forward and aft.

(b) Use of Row Count for Curtailment. When using row count, the required row factor is 2.96. The row factor is multiplied by the standard deviation and the difference between average male and average female weights is added to provide the additional weight consideration. In our example, the standard deviation is calculated from the NHANES data as 47 pounds, and the difference between average all-male and average passenger weights is 10 pounds. The resulting additional weight for curtailment is $47 \times 2.96 + 10 = 149$ pounds. This additional weight is applied as if a 2-row passenger zone concept is used for passenger seating. The resulting curtailment is determined to be 16,657 inch-pounds forward and aft.

(3) Variations to Fuel Density. Since the loading of fuel does not significantly shift the CG for the aircraft, it is not necessary to correct for variations in fuel density (i.e., the correction is negligible).

(4) Fuel Movement in Flight. Fuel movement has been considered by the manufacturer in the development of the certified envelope, making an additional curtailment unnecessary.

(5) Fluids. The sample aircraft does not have a lavatory and there is no catering.

(6) Baggage and Freight. The sample aircraft provides a baggage web in the aft baggage compartment, splitting the compartment into forward and aft sections. In our example, we assume the operator is making full use of this web and the movement of baggage is restricted. No curtailment is necessary.

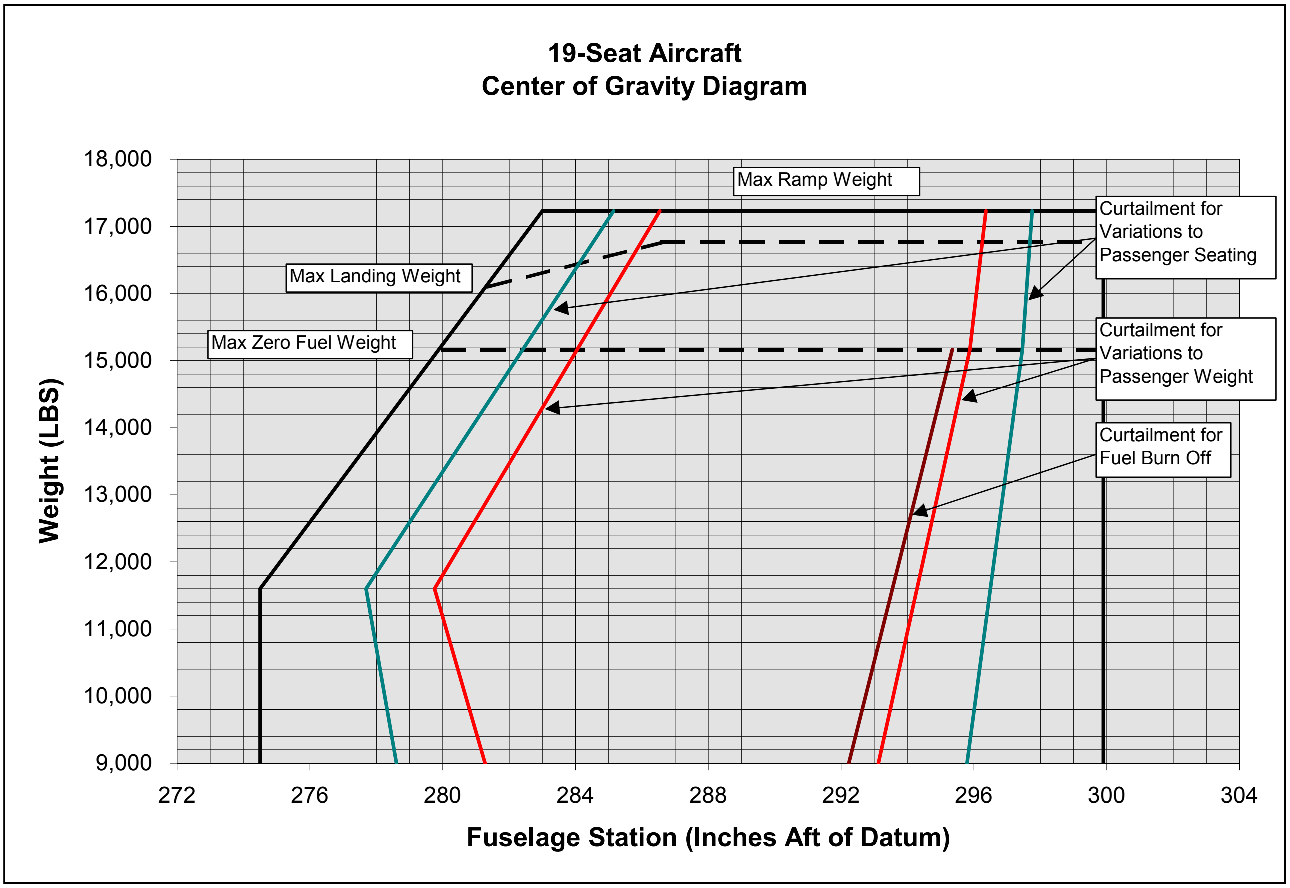
(7) In Flight Movement of Passengers and Crew. Since there are no flight attendants and no lavatories on the sample aircraft, it is reasonable to assume that the passengers will remain in their seats for the duration of the flight. Therefore, it is not necessary to curtail the limits for passenger and crew in-flight movement.

(8) Movement of Flaps and Landing Gear. In the case of the sample aircraft, the manufacturer has included consideration of flap and landing gear movement in the development of the certified envelope. No additional curtailment is necessary.

(9) Fuel consumption. The fuel vector for the sample aircraft provides a small aft movement that requires a -8,900 inch-pounds curtailment to the aft zero fuel weight limits to ensure the aircraft does not exceed the aft limit as fuel is burned. This equates to a -0.8 inch curtailment at an estimated operational empty weight of 11,000 pounds with a linear transition to a -0.6 inch curtailment at MZFW of 16,155 pounds. In this example, the 8,900 inch-pounds is the fuel burn deviation that would bring the aircraft outside the aft CG limit during the course of flight.

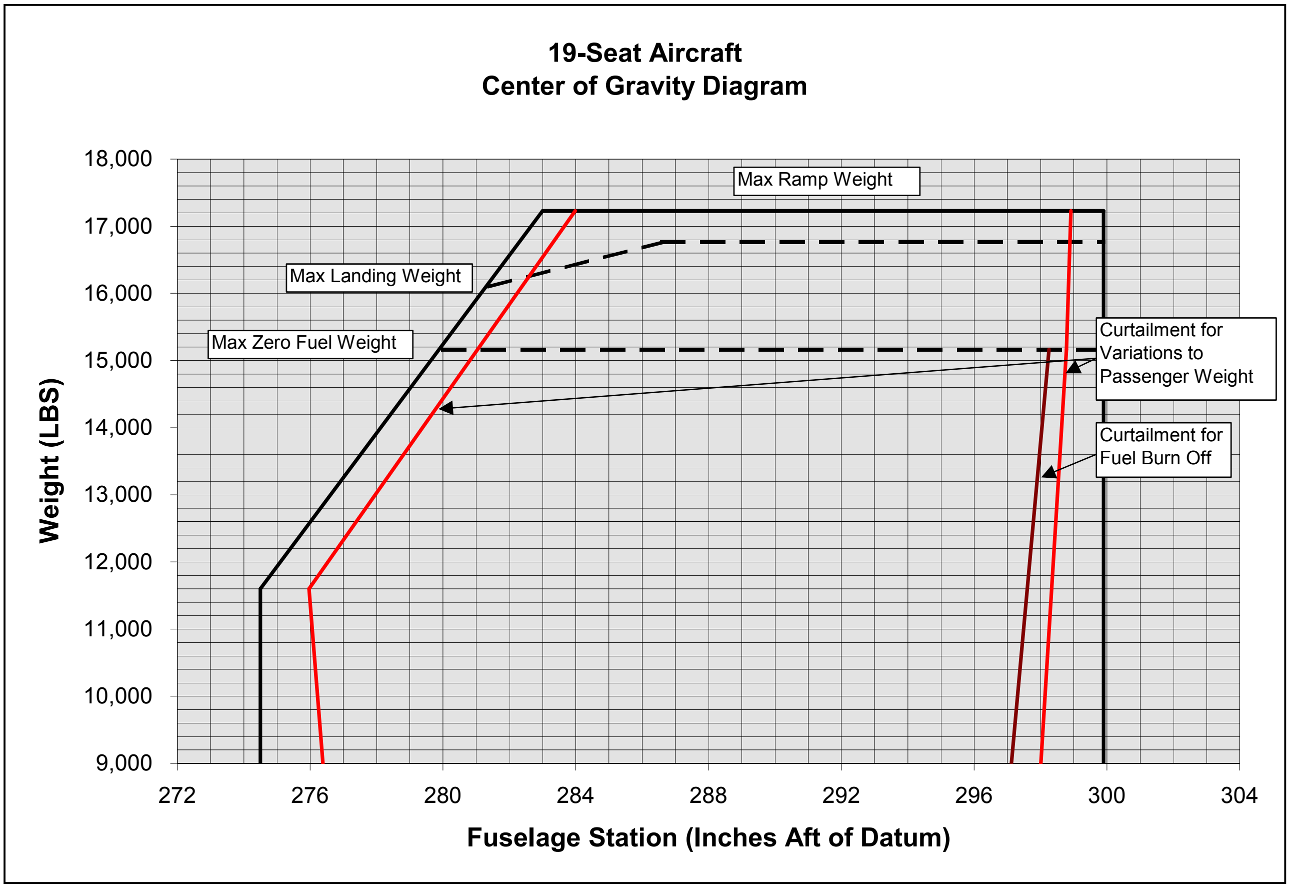
b. Three operational curtailments to the sample aircraft CG envelope are required. These are for variations to passenger seating and passenger weight, and fuel burn-off. Figure 6-1 displays the operational CG envelope highlighting the required curtailments.

FIGURE 6-1. OPERATIONAL CG ENVELOPE—3 PASSENGER CABIN ZONES



c. Assuming the operator wishes to widen the envelope, use of actual passenger seating (row count) may be used to eliminate the curtailment required for variations to passenger seating. Figure 6-2 displays a CG envelope that makes use of actual passenger seating.

FIGURE 6-2. OPERATIONAL CG ENVELOPE—ACTUAL PASSENGER SEATING



d. No-Carry-On Baggage Program. This example assumes a no-carry-on bag program. This allows consideration of reduced passenger weight to 184 pounds (summer) and 189 pounds (winter). Carry-on bags checked at the gate or "plane-side loaded" will be counted as 20 pounds/bag. Bags checked at the ticket counter will remain at 30 pounds/bag.

APPENDIX 7. CHECKLIST

Aircraft Type ___________________________

Region ________________________________

Route ________________________________

Aircraft Size / Carry-on Bag Assessment

1 Is the aircraft certificated under part 23 commuter category, part 25, or part 29 (or has equivalent performance data)?
(Yes or No) ☐

2 What is the certified maximum number of seats for the aircraft? ☐

If answer to (2) is greater than 70, then aircraft is large cabin size. If answer to (2) is less than 30, then aircraft is small cabin size. If answer to (2) is 30 to 70, then aircraft is medium cabin size. Continue with next question.

3a Does aircraft CG at OEW and at ZFW when fully loaded with passengers and cargo at 10 lbs/cu.ft. fall within the manufacturer's certified envelope limits? (Yes or No) ☐

3b Does operator's loading schedule use passenger zone loading with no more than 4 rows per zone with not less than 4 zones or does operators loading schedule use passenger row count? (Yes or No) ☐

If answer to either (3a) or (3b) is yes, then aircraft weight & balance program may follow large aircraft cabin guideline. If answer to (3a) and (3b) is no, then aircraft weight & balance program should follow small cabin aircraft guidelines.

4 Does operator have in place a program that will prohibit placing of carry-on bag in passenger compartment? (Yes or No) ☐

If answer to (4) is yes, then the aircraft is eligible to be included in a no carry-on bag program. If answer to (4) is no, aircraft is not eligible for carry-on bag program.

5 Aircraft weight & balance program guidelines (Small or Large) ☐

6 Aircraft eligible for no carry-on bag program? (Yes or No) ☐

Passenger Weights Assumptions

7 Was a valid and current passenger weight survey performed? (Yes or No) ☐

The survey may include passenger weights and/or Male/Female ratios. If yes, then the passenger weights used should reflect the results of the survey.

8 Was a valid and current carry-on bag weight survey performed? (Yes or No) ☐

The survey may include checked bag weights and/or counts. If the answer to (8) is yes, then the passenger weights used should reflect survey results.

9 Will aircraft weight & balance program follow small aircraft guidelines? (Yes or No) ☐

If answer to (9) is yes, proceed with next question. If answer is no, go to question (12).

10 Will segmented passenger weights be used? (Yes or No) ☐

If answer to (10) is yes, use segmented passenger weights per Appendix 3 and go to question (12).

11 If answer to question (1) is Yes, will standard average passenger weights be used? (Yes or No) ☐

If answer to (11) is yes, use standard average passenger weights per Chapter 4.

12 If answer to question (6) is Yes, does operator intend to include aircraft in a no carry-on bag program? (Yes or No) *If answer to (12) is yes, adjust passenger weight assumptions by -6 lb/pax.* ☐

CHECKLIST (cont.)

13 Will actual, separate Male and Female weights be used? (Yes or No)

If answer to (13) is yes, then individual male and female weights should be provided in (15) and (16). If answer to (13) is no, then non-gender specific weights should be provided in (15) and (16).

14 Will Child weights be used? (Yes or No)

If answer to (14) is yes, then child weights should be provided in (15) and (16).

15 Adult Male Summer Weight (lb)

Adult Female Summer Weight (lb)

Adult (non-gender specific) Summer Weight (lb)

Child Summer Weight (lb)

16 Adult Male Winter Weight (lb)

Adult Female Winter Weight (lb)

Adult (non-gender specific) Winter Weight (lb)

Child Winter Weight (lb)

Checked Bag Weight Assumptions

17 Was a valid and current checked bag weight survey performed? (Yes or No)

If the answer to (17) is yes, then the checked bag weights used should reflect survey results. If no, then standard average checked bag weights as defined in Chapter 4 should be used.

18 If answer to question (6) is yes, does operator intend to include aircraft in a no-carry-on bag program? (Yes or No)

If answer to question (18) is yes, then carry-on bags checked plane-side should be counted as weighing 20 lb. each.

19 Does operator have an approved heavy bag program?

If the answer to (19) is yes, then bags over 50 lb and less than 100 lb are counted as 60 lb. If (19) is no, then actual weights should be used for bags weighing over 50 lb.

20 Domestic Checked Bag Weight (lb)

21 International Checked Bag Weight (lb)

22 Plane-side Checked Bag Weight (lb)

CHECKLIST (cont.)

Center of Gravity Envelope Curtailment

Which method of passenger seating assumptions will be used?

23 - Actual seat assignment? (Yes or No)

If (23) is yes, then curtailment to the center of gravity envelope for variation in passenger seating not required. If yes, proceed to question (27). It may be appropriate for the operator to provide a small curtailment to accommodate passengers not sitting in their assigned seats if the operator does not have a program in place to ensure passengers are sitting in their assigned seats.

24 - Random seating with single cabin zone? (Yes or No)

If (24) is yes, then curtailment to the center of gravity envelope for variation in passenger seating required per a documented method, such as Boeing window-aisle-remaining or Airbus root mean square methods. Passenger weight used in the loading system should be used when developing the curtailments. If yes, proceed to question (27).

25 - Random seating with multiple cabin zones? (Yes or No)

If (25) is yes, then curtailment to the center of gravity envelope for variation in passenger seating for each passenger cabin zone is required per a documented method, such as Boeing window-aisle-remaining or Airbus root mean square methods. The curtailments for each passenger cabin zone are summed to provide the total curtailment required for random passenger seating. Passenger weight used in the loading system should be used when developing the curtailments. If yes, proceed to question (27).

26 - Historically-based? (Yes or No)

If (26) is yes, then forward and aft curtailments to center of gravity envelope should be calculated to a 95% confidence level based on recorded data. Passenger weight used in the loading system should be used when developing the curtailments.

27 Will aircraft weight & balance program follow small aircraft guidelines? (Yes or No)

If answer to (27) is yes, operator should curtail center of gravity envelope for variations to passenger weight per Appendix 4.

28 Has aircraft manufacturer included variation to fuel density considerations in the development of the certified center of gravity envelope? (Yes or No)

If the answer to (28) is no, then operator should curtail center of gravity envelope for expected variations in fuel density.

29 Does aircraft's fuel burn moment cause the aircraft to exceed the forward or aft center of gravity limits anytime during flight? (Yes or No)

If answer to (29) is yes, then operator should curtail center of gravity envelope to ensure fuel burn will not result in a limit exceedance unless the manufacturer has already considered this in the development of the certified center of gravity envelope.

30 Has aircraft manufacturer included consideration of fuel movement in the development of the certified center of gravity envelope, e.g., fuel transfer between tanks? (Yes or No)

If the answer to (30) is no, then operator should curtail center of gravity envelope for other fuel movement expected in flight.

31 Does aircraft have galley and/or lavoratory in the cabin? (Yes or No)

If answer to (31) is yes, then operator should curtail center of gravity envelope for movement of potable water and/or lavoratory fluids in flight. Operator should also curtail for movement of passengers and crew members to lavoratories and flight attendant with serving cart moving through cabin.

32 Does the operator use procedures which ensure that the cargo is loaded uniformly throughout each compartment? (Yes or No)

If answer to (32) is no, then operator should curtail center of gravity envelope to accommodate expected shifting of cargo load.