



U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Obsolete

Subject: AIRCRAFT WEIGHT AND BALANCE
CONTROL

Date: 10/25/90
Initiated by: AFS-330

AC No: 120-27B
Change:

1. PURPOSE. This advisory circular (AC) provides a method and procedures for developing a weight balance control system.
2. FOCUS. This document provides guidance to certificate holders that are required to have an approved weight and balance program by Federal Aviation Regulations (FAR) Part 121 or elect to have an approved program under FAR Part 135.
3. CANCELLATION. AC 120-27A, Aircraft Weight and Balance Control, dated May 14, 1980.
4. DISCUSSION. An operator may submit, for inclusion into its operations specifications, any method and procedure which shows that an aircraft will be properly loaded and will not exceed approved weight and balance limitations during operation. The approval of such a weight and balance control system is based on an evaluation of the program presented for a particular aircraft and of a particular operator's ability to implement that program. Whatever method is used, the program should account for all probable loading conditions which may be experienced in service and show that the loading schedule developed will ensure satisfactory aircraft loading within the approved limits during ground operations and throughout each flight.
5. CONTENTS. Weight and balance control systems encompass the following:
 - a. Methods for establishing, monitoring, and adjusting individual aircraft or fleet empty weight and center of gravity (CG) in conjunction with the initial and periodical reweighing of aircraft.
 - b. A loading schedule composed of graphs, tables, and computations, etc., whereby the various weight and balance conditions of an aircraft may be established based on pertinent data for use in loading that particular aircraft in a satisfactory manner.
 - c. Procedures for using the loading schedule to establish that the loaded condition of the aircraft is within approved weight and CG limits.

d. A load manifest to document loading information by personnel responsible for weight and balance control and procedures for its preparation.

e. Procedures for crewmembers, cargo handlers, and other personnel concerned with aircraft loading, giving complete details regarding distribution of passengers, fuel, cargo, and necessary restrictions to passenger movement on the ground and during flight.

f. The program should provide for operational performance factors such as takeoff and landing away accountability and en route and taxi fuel burnoff.

6. TERMS, DESCRIPTIONS, AND GENERAL STANDARDS.

a. Empty Weight. The weight of the airframe, engines, propellers, rotors, and fixed equipment. Empty weight excludes the weight of the crew and payload but includes the weight of all fixed ballast, unusable fuel supply, undrainable oil, total quantity of engine coolant, and total quantity of hydraulic fluid (see FAR Section 135.2(e)(2)). The empty weight of an aircraft is the maximum gross weight less the following:

(1) All fuel and oil, except system fuel and oil. System fuel and oil are the amounts required to fill both systems and the tanks, where applicable, up to the outlets to the engines. When oil is used for propeller feathering, such oil is included as system oil.

(2) Crew and crew baggage.

(3) Drainable antidetonant injection, augmentation, and deicing fluids.

(4) Passengers and cargo (revenue and nonrevenue).

(5) Removable passenger service equipment, food, magazines, etc., including drainable washing and potable water.

(6) Emergency equipment (overwater, tropical, and frigid).

(7) Other equipment variable for flights.

(8) Flight spares (spark plugs, wheel, cylinder, etc.)

b. Operating Weight. The basic operating weight established by the operator for a particular model aircraft should include the following standard items in addition to the empty weight of the aircraft or as otherwise specified by the operator.

(1) Normal oil quantity.

(2) Antidetonant injection, augmentation, and deicing fluids.

(3) Crew and crew baggage.

(4) Passenger service equipment, including washing and potable water, magazines, etc.

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

(6) Emergency equipment, if required, for all flights.

c. A detailed listing of the items comprising empty weight and operating weight should be included in the operator's program.

d. Structural Limits. Weight and CG limits are established at the time of aircraft certification. They are specifically in, or referenced by, the applicable type certificate data sheet or aircraft specification. The operator's weight and balance program should provide for maintaining these limits. The operator's program should stress the point the aircraft must be operated at or below its maximum certificated operating weight. Following are general definitions of structural weight limits normally considered in weight and balance programs.

(1) Maximum Zero Fuel Weight. The maximum zero fuel weight means the maximum permissible weight of an aircraft with no disposable fuel or oil (see FAR Sections 121.198(b) and 135.2(e)(3)).

(2) Maximum Landing Weight. The landing weight limit is the maximum weight at which the aircraft may normally be landed. Some aircraft are equipped to jettison fuel as an abnormal measure to reduce aircraft weight down to the landing limit.

(3) Maximum Takeoff Weight. This is the maximum allowable, total loaded aircraft weight at the start of the takeoff run.

(4) Maximum Ramp Weight. This is the maximum allowable, total loaded aircraft weight for taxi.

7. AIRCRAFT WEIGHT ESTABLISHMENT. Aircraft weight and balance control systems normally contain provisions for determining aircraft weight in accordance with the following procedures:

a. Individual Aircraft Weight and Changes. The loading schedule may utilize the individual weight of the aircraft in computing pertinent gross weight and balance. The individual weight and CG position of each aircraft should be confirmed at the specified reweighing periods. In addition, it should be reestablished by reweighing whenever the cumulative change to the operating weight exceeds plus or minus one-half of 1 percent of the maximum landing weight or 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 Weights, Establishment, and Changes. For a fleet group of aircraft of the same model and configuration, an average operating fleet weight may be utilized if the operating weights and CG position are within the limits established herein. The fleet weight should be calculated on the following basis:

(1) An operator's empty fleet weight is usually determined by weighing aircraft according to the following table: for a fleet of 1 to 3, weigh all aircraft; for a fleet of 4 to 9, weigh 3 aircraft plus at least 50 percent of the number over 3; for fleets of over 9, weigh 6 aircraft plus at least 10 percent of the number over 9.

(2) In choosing the aircraft to be weighed, the aircraft in the fleet having the highest time since last weighing should be selected. When the average empty weight and CG position have been determined for aircraft weighed and the fleet operating weight established, necessary data should be computed for aircraft not weighed but which are considered eligible under such fleet weight. If the operating weight of any aircraft weighed or the calculated operating weight of any of the remaining aircraft in the fleet varies by an amount exceeding plus or minus one-half of 1 percent of the maximum landing weight from the established operating fleet weight or the CG position varies more than plus or minus one-half of 1 percent of the MAC from the fleet CG, the aircraft should be omitted from that group and operated on its actual operating weight and CG position. If it falls within the limits of another fleet or group, it may then become part of the fleet. In cases where the aircraft is within the operating fleet weight tolerance but the CG position varies in excess of the tolerance allowed, the aircraft may still be utilized under the applicable operating fleet weight but with an individual CG position.

(3) Reestablishment of the operator's empty fleet weight or operating fleet weight and corresponding CG positions may be accomplished between weighing periods by calculation based on the current empty weight of the aircraft previously weighed for fleet weight purposes. Weighing for reestablishment of fleet weights is normally conducted on a 3-year basis unless a shorter period is desired by the operator.

c. 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 within 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 weighing.

d. Periodic Weighing - Aircraft Using Individual Weights. Aircraft operated under a loading schedule utilizing individual aircraft weights in computing the gross weight are normally weighed at intervals of 36 calendar months. An operator may, however, extend this weight 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 in paragraph 7a. Such applications should be limited to increases in increments of 12 months and should be substantiated in each instance with at least two aircraft weighed. Increases 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 which is equivalent to the aircraft overhaul period.

e. Periodic Weighing - Aircraft Using Fleet Weights. Aircraft operating under fleet weights should be weighed in accordance with procedures outlined for the establishment of fleet weights. Since each fleet is normally reestablished every 3 years and a specified number of aircraft weighed at such periods, no additional weighing is considered necessary. A rotation program should, however, be incorporated so all aircraft in the fleet will be weighed periodically.

f. Weighing Procedure. Normal precautions, consistent with good practices, should be taken such as checking the aircraft equipment list to ensure the aircraft has the items of installed equipment contained in the list, determining that the fluids are properly accounted for, that the aircraft is clean, and that weighing is accomplished in an enclosed building. Any acceptable scales may be used for weighing provided they are properly calibrated, zeroed, and used in accordance with the manufacturer's instructions. Each scale should have been calibrated, either by the manufacturer or by a civil department of weights and measures, within 1 year prior to weighing any aircraft for this purpose unless the operator has evidence which warrants a longer period between calibrations.

8. LOADING SCHEDULE. Loading schedules should be simple and orderly, based on sound principles, thus reducing the elements of human error. Loading schedules may be applied to individual aircraft or to a complete fleet. When an operator utilizes several types of models of aircraft, a loading schedule, which may be index-type, tabular-type, or a computer, should be identified with the type of model or aircraft for which it is designed.

9. LOADING PROVISIONS. All seats, compartments, and other loading stations should be properly marked and the identification used should correspond with the instructions established for computing weight and balance of the aircraft. When the loading schedule provides for blocking off seats or compartments in order to remain within the CG limits, effective means should be provided to ensure that such seats or compartments are not occupied during operations specified.

In such cases, instructions should be prepared for crewmembers, cargo handlers, and other personnel concerned, giving complete information regarding distribution of passengers, cargo, fuel, and other items. Information relative to maximum capacities and other pertinent limitations affecting the weight or balance of the aircraft should be included in these instructions. When it is possible by adverse distribution of passengers to exceed the approved CG limits of the aircraft, special instructions should be issued to the pilot in command and appropriate crewmembers so that the load distribution can be maintained within the approved limitation. A suitable commercial scale should be available for use when passenger, baggage, and cargo weights are otherwise undeterminable.

10. PASSENGER WEIGHTS. Actual or average passenger weights may be used to compute passenger loads over any segment of a certificate holder's operations. However, actual weight should be used for operations with reciprocating powered aircraft of nine or less seats and for all operations involving nonstandard weight passenger groups. Both methods may be used interchangeably provided only one method is used for any flight from originating to terminating point, except as indicated in subparagraph b.

The loading system should readily accommodate nonstandard weight groups, and the manifest should indicate whether average or actual weights, or a combination thereof, were used in the computation.

a. Average Passenger Weight. The standard average passenger weights listed in the following table were derived from an extensive survey of conventional airline passenger groups. They should not be arbitrarily adopted for operations with passenger groups that appreciably differ from the basis. Special average weights may be established for particular operations based on surveys indicating those weights consistently provide for loading within prescribed weight and balance limits. Predominantly male passenger groups usually warrant higher averages.

STANDARD AVERAGE PASSENGER WEIGHTS

Summer - for the period of May 1 through October 31:

Adult Passenger.....170 pounds

Winter - for the period of November 1 through April 30:

Adult Passenger.....175 pounds

Summer/Winter

Children.....80 pounds
(Applicable between ages 2 and 12)

The average weight for children normally is used only when needed to accommodate available payload. Otherwise, as ticketed passengers, they are considered the same as adult passengers. Children less than 2 years old are considered babes in-arms, and their weight is considered negligible.

Note: The intention of this AC is to provide methods and procedures for developing weight and balance control systems, not to address the entire spectrum of all possible weight configurations. Therefore, the operator should consider providing the Federal Aviation Administration with a reliable survey to establish an average passenger weight for its specific operation.

NONSTANDARD PASSENGER WEIGHTS

Actual passenger weights are used on flights reserved wholly by nonstandard weight groups. This includes athletic squads and other groups which are larger or smaller than the U.S. average; for compliance purposes, actual weights can be verbally solicited and 10 pounds per passenger added to allow for hand baggage, clothing variables, etc.

NONSTANDARD PASSENGER WEIGHTS--MILITARY GROUPS

Noncombat-Equipped Military Personnel.....195 pounds

Note: This weight includes 20 pounds of hand-carried baggage.

Combat-Equipped Military Personnel.....225 pounds

Note: This represents the standard combat soldier as would be seen on contract flights involving large movements. This includes 195 pounds as shown above, 20 pounds for additional hand-carried mobility pack, and additional 10 pounds for hand-carried weapons.

b. Actual Passenger Weights. Actual passenger weights should be used in the case of flights carrying large groups of passengers whose average weight obviously does not conform to the normal standard weight, such as athletic squads or other groups which are smaller or larger than the U.S. average. Where such groups form only a part of the total passenger load, actual weights 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; i.e., football squad, etc. Actual weights should be used for aircraft with small passenger capacities in which deviations from average weights could result in exceeding weight and balance limits. For example, there are numerous commuter type aircraft with a nine or less seating configuration that cannot carry full fuel and passenger loads simultaneously. These aircraft should use actual weights for their passengers and baggage.

c. Actual passenger weight may be determined by:

(1) Scale weighing of each passenger prior to boarding the aircraft, including minor articles carried aboard by the passenger.

(2) Asking each passenger his/her weight and adding to it a predetermined constant to provide for hand-carried articles and also to cover possible seasonal effect upon passenger weight due to variance in clothing weight. This constant may be approved for an operator on the basis of studies by the operator that consider particular routes and seasonal variations, when applicable. Personnel listing passengers on this basis should receive instruction for estimating passenger weights to reasonably confirm their accuracy.

11. CREW WEIGHT. For crewmembers, the following approved average weights may be used:

- a. Male cabin attendants 150 pounds; female cabin attendants 130 pounds.
- b. Male flight crewmembers 170 pounds; female flight crewmembers 130.

12. PASSENGER AND CREW BAGGAGE. Procedures should be provided so that all baggage, including that carried aboard by the passengers, is properly accounted for. If desired by the operator, a standard crew weight may be used. The use of actual weights is critical and required for FAR Part 135 reciprocating engine-powered aircraft of nine or less passengers. The following average passenger baggage weights may be approved for use in turbine-powered aircraft:

a. For FAR Part 135 operations with turbine-powered aircraft and/or aircraft type certificated for 10 or more passenger seats, an operator may establish average passenger baggage weights predicated on a study of actual baggage weights for the operations or routes involved that consider seasonal and other variables.

b. For FAR Part 121 domestic operations:

(1) For each piece of checked baggage, an average of not less than 23.5 pounds; and

(2) For each passenger boarding the aircraft, an average of not less than 10 pounds is added for hand baggage whether or not such baggage is carried by the passenger.

c. For FAR Part 121 flag and supplemental operations:

(1) For each piece of checked baggage, an average of not less than 26.5 pounds.

(2) For each passenger boarding the aircraft, not less than 10 pounds is added for hand baggage whether or not such baggage is carried by the passenger.

Note: Average passenger baggage weights should not be used in computing the weight and balance of charter flights and other special services involving the carriage of special groups.

13. TRAVEL DURING FLIGHT. The operator should show that the procedures fully account for the extreme variation in CG travel during flight caused by all or any combination of the following variables:

a. The operator should compute the movement of passengers and cabin attendants from their normal position in the aircraft cabin to other areas such as the lounge or lavatory. If the capacity of such compartment is one, the movement of either one passenger or one cabin attendant, whichever most adversely affects the CG condition, should be considered. When the capacity of the lavatory or lounge is two or more, the movement of that number of passengers or cabin attendants from positions evenly distributed throughout the aircraft may be used. Where seats are blocked off and the movement of passengers and/or cabin attendants is evenly distributed throughout, only the actual loaded section of the aircraft should be used. The extreme movements of the cabin attendants carrying out their assigned duties within the cabin should be considered. The various conditions should be combined in such a manner that the most adverse effect on the CG will be obtained and accounted for in the development of the loading schedule to assure the aircraft is loaded within the approved limits at all times during the ground and flight operations.

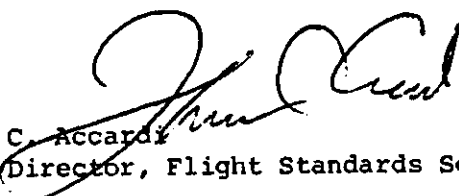
b. Landing Gear Retraction. Possible change in CG position due to landing gear retraction should be investigated and results accounted for.

c. Fuel. The effect of the CG travel within the aircraft during flight, due to fuel used down to the required reserve fuel or to an acceptable minimum reserve fuel established by the operator, should be accounted for.

14. RECORD. The weight and balance system should include methods by which the operator will maintain a complete, current, and continuous record of the weight and CG of each aircraft. Such records should reflect all alterations and changes affecting either the weight or balance of the aircraft and will include a complete and current equipment list. When fleet weights are used, pertinent computations should also be available in individual aircraft files.

15. 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.

16. CONTENT OF OPERATIONS SPECIFICATIONS PROCEDURES FOR AIRCRAFT WEIGHT AND BALANCE CONTROL. The operations specifications should contain the procedures (or make reference to the operator's approved weight and balance control program document) used to maintain control of weight and balance of all aircraft operated under the terms of the operating certificate which assures that the aircraft, under all operating conditions, is loaded within weight and CG limitations. This description should include a reference to the procedures used for determining weight of passengers/crew, weight of baggage, periodic aircraft weighing, type of loading devices, and identification of the aircraft concerned.



Thomas C. Accardi
Acting Director, Flight Standards Service



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5. CONTENTS. Weight and balance control systems encompass the following:
 - a. Methods for establishing, monitoring, and adjusting individual aircraft or fleet empty weight and center of gravity (CG) in conjunction with the initial and periodical reweighing of aircraft.
 - b. A loading schedule composed of graphs, tables, and computations, etc., whereby the various weight and balance conditions of an aircraft may be established based on pertinent data for use in loading that particular aircraft in a satisfactory manner.
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d. A load manifest to document loading information by personnel responsible for weight and balance control and procedures for its preparation.

e. Procedures for crewmembers, cargo handlers, and other personnel concerned with aircraft loading, giving complete details regarding distribution of passengers, fuel, cargo, and necessary restrictions to passenger movement on the ground and during flight.

f. The program should provide for operational performance factors such as takeoff and landing away accountability and en route and taxi fuel burnoff.

6. TERMS, DESCRIPTIONS, AND GENERAL STANDARDS.

a. Empty Weight. The weight of the airframe, engines, propellers, rotors, and fixed equipment. Empty weight excludes the weight of the crew and payload but includes the weight of all fixed ballast, unusable fuel supply, undrainable oil, total quantity of engine coolant, and total quantity of hydraulic fluid (see FAR Section 135.2(e)(2)). The empty weight of an aircraft is the maximum gross weight less the following:

(1) All fuel and oil, except system fuel and oil. System fuel and oil are the amounts required to fill both systems and the tanks, where applicable, up to the outlets to the engines. When oil is used for propeller feathering, such oil is included as system oil.

(2) Crew and crew baggage.

(3) Drainable antidetonant injection, augmentation, and deicing fluids.

(4) Passengers and cargo (revenue and nonrevenue).

(5) Removable passenger service equipment, food, magazines, etc., including drainable washing and potable water.

(6) Emergency equipment (overwater, tropical, and frigid).

(7) Other equipment variable for flights.

(8) Flight spares (spark plugs, wheel, cylinder, etc.)

b. Operating Weight. The basic operating weight established by the operator for a particular model aircraft should include the following standard items in addition to the empty weight of the aircraft or as otherwise specified by the operator.

(1) Normal oil quantity.

(2) Antidetonant injection, augmentation, and deicing fluids.

(3) Crew and crew baggage.

(4) Passenger service equipment, including washing and potable water, magazines, etc.

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

(6) Emergency equipment, if required, for all flights.

c. A detailed listing of the items comprising empty weight and operating weight should be included in the operator's program.

d. Structural Limits. Weight and CG limits are established at the time of aircraft certification. They are specifically in, or referenced by, the applicable type certificate data sheet or aircraft specification. The operator's weight and balance program should provide for maintaining these limits. The operator's program should stress the point the aircraft must be operated at or below its maximum certificated operating weight. Following are general definitions of structural weight limits normally considered in weight and balance programs.

(1) Maximum Zero Fuel Weight. The maximum zero fuel weight means the maximum permissible weight of an aircraft with no disposable fuel or oil (see FAR Sections 121.198(b) and 135.2(e)(3)).

(2) Maximum Landing Weight. The landing weight limit is the maximum weight at which the aircraft may normally be landed. Some aircraft are equipped to jettison fuel as an abnormal measure to reduce aircraft weight down to the landing limit.

(3) Maximum Takeoff Weight. This is the maximum allowable, total loaded aircraft weight at the start of the takeoff run.

(4) Maximum Ramp Weight. This is the maximum allowable, total loaded aircraft weight for taxi.

7. AIRCRAFT WEIGHT ESTABLISHMENT. Aircraft weight and balance control systems normally contain provisions for determining aircraft weight in accordance with the following procedures:

a. Individual Aircraft Weight and Changes. The loading schedule may utilize the individual weight of the aircraft in computing pertinent gross weight and balance. The individual weight and CG position of each aircraft should be confirmed at the specified reweighing periods. In addition, it should be reestablished by reweighing whenever the cumulative change to the operating weight exceeds plus or minus one-half of 1 percent of the maximum landing weight or 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 Weights, Establishment, and Changes. For a fleet group of aircraft of the same model and configuration, an average operating fleet weight may be utilized if the operating weights and CG position are within the limits established herein. The fleet weight should be calculated on the following basis:

(1) An operator's empty fleet weight is usually determined by weighing aircraft according to the following table: for a fleet of 1 to 3, weigh all aircraft; for a fleet of 4 to 9, weigh 3 aircraft plus at least 50 percent of the number over 3; for fleets of over 9, weigh 6 aircraft plus at least 10 percent of the number over 9.

(2) In choosing the aircraft to be weighed, the aircraft in the fleet having the highest time since last weighing should be selected. When the average empty weight and CG position have been determined for aircraft weighed and the fleet operating weight established, necessary data should be computed for aircraft not weighed but which are considered eligible under such fleet weight. If the operating weight of any aircraft weighed or the calculated operating weight of any of the remaining aircraft in the fleet varies by an amount exceeding plus or minus one-half of 1 percent of the maximum landing weight from the established operating fleet weight or the CG position varies more than plus or minus one-half of 1 percent of the MAC from the fleet CG, the aircraft should be omitted from that group and operated on its actual operating weight and CG position. If it falls within the limits of another fleet or group, it may then become part of the fleet. In cases where the aircraft is within the operating fleet weight tolerance but the CG position varies in excess of the tolerance allowed, the aircraft may still be utilized under the applicable operating fleet weight but with an individual CG position.

(3) Reestablishment of the operator's empty fleet weight or operating fleet weight and corresponding CG positions may be accomplished between weighing periods by calculation based on the current empty weight of the aircraft previously weighed for fleet weight purposes. Weighing for reestablishment of fleet weights is normally conducted on a 3-year basis unless a shorter period is desired by the operator.

c. 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 within 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 weighing.

d. Periodic Weighing - Aircraft Using Individual Weights. Aircraft operated under a loading schedule utilizing individual aircraft weights in computing the gross weight are normally weighed at intervals of 36 calendar months. An operator may, however, extend this weight 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 in paragraph 7a. Such applications should be limited to increases in increments of 12 months and should be substantiated in each instance with at least two aircraft weighed. Increases 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 which is equivalent to the aircraft overhaul period.

e. Periodic Weighing - Aircraft Using Fleet Weights. Aircraft operating under fleet weights should be weighed in accordance with procedures outlined for the establishment of fleet weights. Since each fleet is normally reestablished every 3 years and a specified number of aircraft weighed at such periods, no additional weighing is considered necessary. A rotation program should, however, be incorporated so all aircraft in the fleet will be weighed periodically.

f. Weighing Procedure. Normal precautions, consistent with good practices, should be taken such as checking the aircraft equipment list to ensure the aircraft has the items of installed equipment contained in the list, determining that the fluids are properly accounted for, that the aircraft is clean, and that weighing is accomplished in an enclosed building. Any acceptable scales may be used for weighing provided they are properly calibrated, zeroed, and used in accordance with the manufacturer's instructions. Each scale should have been calibrated, either by the manufacturer or by a civil department of weights and measures, within 1 year prior to weighing any aircraft for this purpose unless the operator has evidence which warrants a longer period between calibrations.

8. LOADING SCHEDULE. Loading schedules should be simple and orderly, based on sound principles, thus reducing the elements of human error. Loading schedules may be applied to individual aircraft or to a complete fleet. When an operator utilizes several types of models of aircraft, a loading schedule, which may be index-type, tabular-type, or a computer, should be identified with the type of model or aircraft for which it is designed.

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In such cases, instructions should be prepared for crewmembers, cargo handlers, and other personnel concerned, giving complete information regarding distribution of passengers, cargo, fuel, and other items. Information relative to maximum capacities and other pertinent limitations affecting the weight or balance of the aircraft should be included in these instructions. When it is possible by adverse distribution of passengers to exceed the approved CG limits of the aircraft, special instructions should be issued to the pilot in command and appropriate crewmembers so that the load distribution can be maintained within the approved limitation. A suitable commercial scale should be available for use when passenger, baggage, and cargo weights are otherwise undeterminable.

10. PASSENGER WEIGHTS. Actual or average passenger weights may be used to compute passenger loads over any segment of a certificate holder's operations. However, actual weight should be used for operations with reciprocating powered aircraft of nine or less seats and for all operations involving nonstandard weight passenger groups. Both methods may be used interchangeably provided only one method is used for any flight from originating to terminating point, except as indicated in subparagraph b.

The loading system should readily accommodate nonstandard weight groups, and the manifest should indicate whether average or actual weights, or a combination thereof, were used in the computation.

a. Average Passenger Weight. The standard average passenger weights listed in the following table were derived from an extensive survey of conventional airline passenger groups. They should not be arbitrarily adopted for operations with passenger groups that appreciably differ from the basis. Special average weights may be established for particular operations based on surveys indicating those weights consistently provide for loading within prescribed weight and balance limits. Predominantly male passenger groups usually warrant higher averages.

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Summer/Winter

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(Applicable between ages 2 and 12)

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Note: The intention of this AC is to provide methods and procedures for developing weight and balance control systems, not to address the entire spectrum of all possible weight configurations. Therefore, the operator should consider providing the Federal Aviation Administration with a reliable survey to establish an average passenger weight for its specific operation.

NONSTANDARD PASSENGER WEIGHTS

Actual passenger weights are used on flights reserved wholly by nonstandard weight groups. This includes athletic squads and other groups which are larger or smaller than the U.S. average; for compliance purposes, actual weights can be verbally solicited and 10 pounds per passenger added to allow for hand baggage, clothing variables, etc.

NONSTANDARD PASSENGER WEIGHTS--MILITARY GROUPS

Noncombat-Equipped Military Personnel.....195 pounds

Note: This weight includes 20 pounds of hand-carried baggage.

Combat-Equipped Military Personnel.....225 pounds

Note: This represents the standard combat soldier as would be seen on contract flights involving large movements. This includes 195 pounds as shown above, 20 pounds for additional hand-carried mobility pack, and additional 10 pounds for hand-carried weapons.

b. Actual Passenger Weights. Actual passenger weights should be used in the case of flights carrying large groups of passengers whose average weight obviously does not conform to the normal standard weight, such as athletic squads or other groups which are smaller or larger than the U.S. average. Where such groups form only a part of the total passenger load, actual weights 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; i.e., football squad, etc. Actual weights should be used for aircraft with small passenger capacities in which deviations from average weights could result in exceeding weight and balance limits. For example, there are numerous commuter type aircraft with a nine or less seating configuration that cannot carry full fuel and passenger loads simultaneously. These aircraft should use actual weights for their passengers and baggage.

c. Actual passenger weight may be determined by:

(1) Scale weighing of each passenger prior to boarding the aircraft, including minor articles carried aboard by the passenger.

(2) Asking each passenger his/her weight and adding to it a predetermined constant to provide for hand-carried articles and also to cover possible seasonal effect upon passenger weight due to variance in clothing weight. This constant may be approved for an operator on the basis of studies by the operator that consider particular routes and seasonal variations, when applicable. Personnel listing passengers on this basis should receive instruction for estimating passenger weights to reasonably confirm their accuracy.

11. CREW WEIGHT. For crewmembers, the following approved average weights may be used:

a. Male cabin attendants 150 pounds; female cabin attendants 130 pounds.

b. Male flight crewmembers 170 pounds; female flight crewmembers 130.

12. PASSENGER AND CREW BAGGAGE. Procedures should be provided so that all baggage, including that carried aboard by the passengers, is properly accounted for. If desired by the operator, a standard crew weight may be used. The use of actual weights is critical and required for FAR Part 135 reciprocating engine-powered aircraft of nine or less passengers. The following average passenger baggage weights may be approved for use in turbine-powered aircraft:

a. For FAR Part 135 operations with turbine-powered aircraft and/or aircraft type certificated for 10 or more passenger seats, an operator may establish average passenger baggage weights predicated on a study of actual baggage weights for the operations or routes involved that consider seasonal and other variables.

b. For FAR Part 121 domestic operations:

(1) For each piece of checked baggage, an average of not less than 23.5 pounds; and

(2) For each passenger boarding the aircraft, an average of not less than 10 pounds is added for hand baggage whether or not such baggage is carried by the passenger.

c. For FAR Part 121 flag and supplemental operations:

(1) For each piece of checked baggage, an average of not less than 26.5 pounds.

(2) For each passenger boarding the aircraft, not less than 10 pounds is added for hand baggage whether or not such baggage is carried by the passenger.

Note: Average passenger baggage weights should not be used in computing the weight and balance of charter flights and other special services involving the carriage of special groups.

13. TRAVEL DURING FLIGHT. The operator should show that the procedures fully account for the extreme variation in CG travel during flight caused by all or any combination of the following variables:

a. The operator should compute the movement of passengers and cabin attendants from their normal position in the aircraft cabin to other areas such as the lounge or lavatory. If the capacity of such compartment is one, the movement of either one passenger or one cabin attendant, whichever most adversely affects the CG condition, should be considered. When the capacity of the lavatory or lounge is two or more, the movement of that number of passengers or cabin attendants from positions evenly distributed throughout the aircraft may be used. Where seats are blocked off and the movement of passengers and/or cabin attendants is evenly distributed throughout, only the actual loaded section of the aircraft should be used. The extreme movements of the cabin attendants carrying out their assigned duties within the cabin should be considered. The various conditions should be combined in such a manner that the most adverse effect on the CG will be obtained and accounted for in the development of the loading schedule to assure the aircraft is loaded within the approved limits at all times during the ground and flight operations.


b. Landing Gear Retraction. Possible change in CG position due to landing gear retraction should be investigated and results accounted for.

c. Fuel. The effect of the CG travel within the aircraft during flight, due to fuel used down to the required reserve fuel or to an acceptable minimum reserve fuel established by the operator, should be accounted for.

14. RECORD. The weight and balance system should include methods by which the operator will maintain a complete, current, and continuous record of the weight and CG of each aircraft. Such records should reflect all alterations and changes affecting either the weight or balance of the aircraft and will include a complete and current equipment list. When fleet weights are used, pertinent computations should also be available in individual aircraft files.

15. 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.

16. CONTENT OF OPERATIONS SPECIFICATIONS PROCEDURES FOR AIRCRAFT WEIGHT AND BALANCE CONTROL. The operations specifications should contain the procedures (or make reference to the operator's approved weight and balance control program document) used to maintain control of weight and balance of all aircraft operated under the terms of the operating certificate which assures that the aircraft, under all operating conditions, is loaded within weight and CG limitations. This description should include a reference to the procedures used for determining weight of passengers/crew, weight of baggage, periodic aircraft weighing, type of loading devices, and identification of the aircraft concerned.


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