

## American Aeronautics Advisory Document

On August 11, 2004 the FAA released Advisory Circular AC 120-27D titled Aircraft Weight and Balance Control. This advisory circular supersedes AC 120-27C. In addition, it released new operations specifications A096 and A097 which specify Aircraft Weight and Balance procedures. The advisory circular restructured the methods used to comply with Weight and Balance Control for 135, 91 subpart K, and some 91 operators to procedures practically identical for 121 operators. The advisory circular (herein after named the "AC") addresses basically four different topics:

- 1) It establishes procedures for computing Basic Empty Weight (BEW) and revisions due to equipment changes and computing Basic Operating Weight (BOW), or Operational Empty Weight (OEW).
- 2) It increased the standard passenger weights and standard flight crew weights.
- 3) It defined the procedures used to correct the standard passenger weights for aircraft based upon the number and configuration of seats. It defined procedures for computing standard weights for aircraft that do not meet certain certification and/or performance criteria (segmented weights).
- 4) It defined curtailments to the center of gravity envelope to be applied. The important difference from previous requirements is that the operator must show cg and weight compliance from takeoff to touchdown, not just for takeoff, and must account for passenger and crew movement as well as other restrictions.

The AC divides aircraft in to four categories as a function of seating capacity; large cabin (71 or more seats), medium cabin (30 to 70 seats), and small cabin (5 to 29 seats). Since virtually all corporate aircraft fit into the small cabin category, only the restrictions pertinent to the small cabin category will be addressed in this document. Aircraft not certified under Federal Aviation Regulations part 25 or aircraft with less than five passenger seats must use actual passenger weights, and are not addressed in the AC. The above four items will be discussed individually below.

The procedures for aircraft weighing requirements have not changed for most operators. Each aircraft must be weighed every 36 calendar months, after a major change (e.g. new interior or paint), or transfer from another country. In addition, equipment changes must be documented and the BEW revised accordingly, and if the cumulative weight and cg change exceeds 0.5% of the maximum landing weight or 0.5% MAC, the aircraft must be reweighed. The BOW or OEW must be documented and the new heavier standard crew weights used (e.g. 190 lbs. each for male flight crew without baggage, see table 3-3 on page 24 of the AC). This will have little effect on heavy aircraft (e.g., GV or BD-700), but will affect light jets (e.g. CE 525A or RA 390). If the operator uses American Aeronautics products, the BOW can be rapidly adjusted for actual flight crew weights, to mitigate the effect of these heavier weights.

Small cabin aircraft may use the new standard passenger weights for large aircraft, if they meet the certification and performance criteria listed on page 20 of the AC. Since most corporate jets meet these criteria and do not have overhead storage bins, the no carry-on baggage program applies. The average weights listed in table 3-2 on page 24 of the AC would be applicable if certain curtailments are applied. Tables 3-2 and 3-3 are shown in Figure 1.

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

<b>Average Passenger Weight</b>	<b>Weight Per Passenger</b>
<b>Summer Weights</b>	
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
<b>Winter Weights</b>	
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

**TABLE 3-3. STANDARD CREWMEMBER WEIGHTS**

<b>Crewmember</b>	<b>Average Weight</b>	<b>Average Weight with Bags</b>
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

**FIGURE 1.**

If average weights are used, the curtailments (shrinkage) to the aircraft enter of gravity envelope required are listed in Appendices 3 and 4 of the AC. They address three items:

- 1) Random seating.
- 2) Variation in passenger weight.
- 3) Male/female ratio.

If the operator uses American Aeronautics products, which use actual seating location, the curtailments due to random seating and passenger weight are eliminated. Variation in male/female ratio curtailments may be avoided by always using the standard male weight (worst case scenario), obtaining principle operations inspector (POI) approval of a male/female ratio (e.g. 50/50 or 60/40), or using the actual male/female/child standard weight for each seat as required. This requires a flight crew member to document the gender or age of each seat occupant.

The AC allows operators to complete a survey of their passengers to obtain their own standard average passenger weights. In order to achieve a statistical probability of 95 percent accuracy, over one thousand passengers must be sampled. This is impractical for most operators. In addition, the few large operators who have completed a survey found that the standard weights determined were virtually identical to the standard weights listed in the AC or heavier.

Finally, the AC allows operators of aircraft who do not meet the certification or performance criteria to use standard weights corrected for statistical probability and seating configuration. These are called segmented weights. Use of segmented passenger weights and curtailments are based on the assumptions that: 1) the crew cannot see the passengers and 2) they wish to use standard weights. Thus, to insure a 95 percent probability that the passengers will not exceed the standard weights being used, the standard weights are increased (segmented weights), and the curtailments are increased depending on the number of seats and rows in the aircraft. The increase in standard weights and curtailments resulting from these assumptions are large, and impractical for small aircraft. In addition, the application of these restrictions in some cases, with light or normal passengers, will result in a zero fuel weight and cg significantly different than the actual zero fuel weight and cg. This may yield trim settings and V speeds that are incorrect and potentially dangerous. For these reasons, American Aeronautics discourages the use of segmented weights.

If the operator uses American Aeronautics products, and has Operations Specifications A097 approved (Appendix 1 of this document), the crew has the option of using standard weights or actual weights. Actual weights should be used when obvious deviations from the standard passenger weight, such as of sports teams, are apparent or the curtailed limits are violated due to aircraft loading. By using actual weights and arranging passengers by size, one can normally use all the seats in an aircraft (this varies depending on aircraft type, seating configuration, and BOW location). Also by using actual weights the curtailments are eliminated.

The center of gravity limits published in the Aircraft Flight Manual (AFM) are for takeoff and landing operations. In-flight or cruise limits have not been published for most corporate aircraft. Normally the forward in-flight cg limit is further forward than the takeoff or landing limit. This is the case since nose wheel loading, low speed controllability, and second segment climb limits, which primarily determine the forward takeoff and landing limit are not a factor during cruise. Similarly, the aft in-flight cg limit is further aft, since high lift devices (flaps and slats), which affect the wing center of pressure, and low dynamic pressures, reduce static stability (both longitudinal and lateral, the primary determinant of the aft cg limit) are not a factor. Normally, these wider limits will allow normal passenger and crew movement to occur in cruise without exceeding cg limits. However, since the cg limits were not modified by the manufacturer for cruise, the takeoff and landing cg limits must be considered to be in effect during cruise flight. The AC states that curtailments to the CG envelope must be applied to insure that cg violations due not occur in flight due to the following items:

- 1) Fuel density variation.
- 2) Fuel transfer.
- 3) Fuel consumption.
- 4) Flight crew movement.
- 5) Flight attendant movement.
- 6) Passenger movement.
- 7) Galley cart movement.
- 8) Galley supplies and potable water consumption.
- 9) Lavatory charge or wash water venting overboard.

Fuel density variation (item 1) will require a small curtailment for most aircraft. Items 2 and 3 have the largest effect on cg and therefore require the largest curtailments. However, American Aeronautics' products display cg travel with fuel consumption or transfer, and thus these curtailments can be avoided. Items 4, 5, and 6, crew and passenger movement present the largest curtailments required and must be examined on a case-by-case basis. Generally crew and passenger movement on light aircraft will have a greater cg affect that for heavy aircraft. For light loads, curtailments will usually not be a factor. However, curtailments for heavy or medium loads will affect every aircraft to a greater or lesser extent. For maximum loading, the operator will have to restrict crew and passenger movement. Items 7, 8, and 9 can generally be ignored for most corporate jets since the weight of these items considered are negligible.

Figure 2 shows a typical curtailment for a Lear 35. The curtailments were based upon a maximum fuel density of 6.9 lbs. per gallon and a crew member moving aft to the cabin (aft cg curtailment) or the aft most passenger moving forward to the lavatory (fwd cg curtailment).

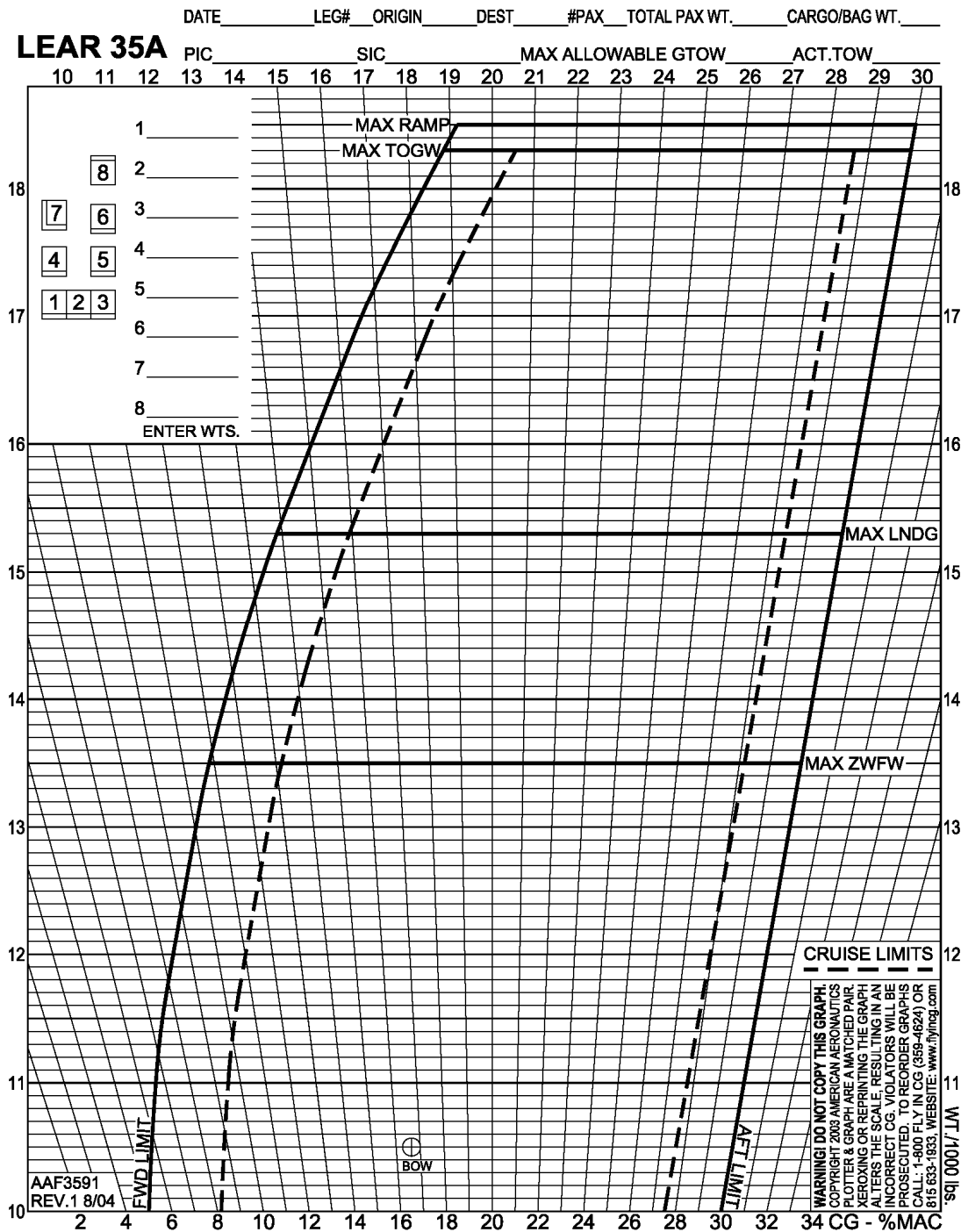


FIGURE 2.

In summary, if an operator wishes to avoid all curtailments, actual passenger weights must be used. If standard weights are to be used, then the curtailments must be applied. The worst curtailments for most corporate jets involve the forward cg limit. The aft cg limit curtailments are generally not an issue. To minimize the severity of the forward cg limit curtailment with medium to heavy loads, several procedures can be inserted into the Ops Specs>:

- 1) The prohibition of passenger movement forward during flight.
- 2) If an aft lavatory is available, all passengers should use it.
- 3) If only a forward lavatory is available, a crewmember or forward passenger can move aft when the lavatory will be used by an aft passenger.
- 4) If the aircraft is to be more than 50% occupied, load the aircraft from aft to forward.

The number of passengers loaded before the curtailments limit the payload will be a function of the aircraft type, seating configuration, and BOW location. An analysis must be completed for each aircraft to determine loading strategies. American Aeronautics has been producing load analyses for 121 operators for 25 years and can rapidly produce a proposed program for each aircraft in your fleet. Either our classic nomographs or new software will allow a weight and balance to be completed in less than a minute. This allows the crew to observe the occupied seats and passengers and generate an accurate result based upon real time data.

**A096. Actual Passenger and Baggage Weight Program For  
All Aircraft**

**HQ Control: 08/11/04  
HQ Revision: 000**

- a. The certificate holder is authorized to use only actual weights when determining the aircraft weight and balance.
- (1) This includes the passenger weights, carry-on bag weights, checked bag weights, plane-side loaded bag weights, and heavy bag weights, and/or
- (2) Actual weights of all passengers and bags or solicited (“asked”) passenger weight plus 10 pounds and actual weight of bags.
- b. If this operations specification is issued, operations specifications A097, A098 and A099 must not be issued.
- c. Operations specifications A011 must be issued if the Part 135 certificate holder has a carry-on baggage program.
- d. The following aircraft must use actual weights:
- (1) All single-engine aircraft, with the exception of single engine turbine-powered EMS helicopters operations
- (2) All reciprocating-powered aircraft, and
- (3) All aircraft certificated with less than five (5) passenger seats, with the exception of single engine turbine-powered EMS helicopters operations
- e. Cargo-Only Jumpseat and/or additional crewmembers.
- (1) For large and medium cabin aircraft used in cargo-only operations, jumpseat occupants and/or additional crewmembers must be accounted for using their actual weight, solicited (“asked”)-weight plus ten pounds, or the standard average flight crewmember weight of 190 pounds.
- (2) For small cabin aircraft used in cargo-only operations, jumpseat occupants and/or additional crewmembers must be accounted for using their actual weight, or solicited (“asked”)-weight plus ten pounds.
- (3) Each bag carried aboard a cargo-only aircraft by a jumpseat occupant and/or additional crewmember will be accounted for as 30 pounds each.
- (4) For cargo-only operated aircraft, standard flight crewmember average weights and flight crewmember average bag weights, as listed in AC 120-27 (as revised) may be included in the basic empty weight of the aircraft.

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**A097. Small Cabin Aircraft Passenger and Baggage Weight Program**

**HQ Control: 08/11/04**  
**HQ Revision: 000**

a. The certificate holder is authorized to use actual weights or the following combinations of actual, standard average (or segmented), or survey-derived average weights as listed in Table 1 for small cabin aircraft (certificated for 5-29 passenger seats) passenger and baggage weight programs:

**Table 1. Selectable Weights – Small Cabin Aircraft (5-29 Seats)**

Type of Operation	M/F Ratio	Passenger Weight			Carry-On/Personal Item Weight			Checked Baggage Weight			Plane-Side-Loaded Baggage Weight			Heavy Baggage Weight		
		Auth.	S/W Wt.	Exp. Yr/Mo	Auth.	Wt.	Exp. Yr/Mo	Auth.	Wt.	Exp. Yr/Mo	Auth.	Wt.	Exp. Yr/Mo	Auth.	Wt.	Exp. Yr/Mo
TABL01	TAB L02	TABL03	TABL04	TABL05	TABL06	TAB L07	TABL08	TABL09	TAB L10	TABL11	TABL12	TAB L13	TABL14	TABL15	TAB L16	TABL17

b. Limitations and Provisions.

(1) All single engine aircraft, all reciprocating engine powered aircraft, and all aircraft certificated with less than five (5) passenger seats; with the exception of single engine turbine-powered EMS helicopters operations, must use actual weights.

(2) Certificate holders that operate small cabin aircraft may use any one of the following methods when calculating the aircraft weight and balance.

(a) The certificate holder may use actual passenger and bag weights, or

(b) The certificate holder may use the segmented passenger weights and average bag weights listed in Advisory Circular 120-27 (as revised), or

(c) The certificate holder may use the standard average passenger and bag weights prescribed for large cabin aircraft, or average weights based on a survey, if:

(i) The aircraft was certificated under commuter category, part 25, or part 29 (or has equivalent performance data), and

(ii) The certificate holder curtails the aircraft CG envelope as prescribed in AC120-27 (as revised) Appendixes 3 and 4.

(3) Survey-derived average weights must be re-validated every 36 calendar months from the date the survey was completed. The survey expiration date must be entered in Table 1 and/or Table 2, as applicable. If survey weights are not being used, enter N/A in each expiration cell in Table 1 and/or Table 2, as applicable.

(4) For actual weights listed in Table 1 and/or Table 2, as applicable, the certificate holder must use:

- (a) Actual weights of all passengers and bags; or
- (b) Solicited (“asked”) passenger weight plus 10 pounds, and actual weight of bags.

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(6) Certificate holders that only use the standard Advisory Circular 120-27 (as revised) average weights listed in Table 1 and/or Table 2, as applicable, and allow carry-on bags onboard the aircraft, must comply with the following criteria:

- ❖ a 50/50 male/female ratio for summer/winter passenger weights 190/195 pounds,
- ❖ 16 pounds for carry-on/personal items (included in the average passenger weight),
- ❖ 30 pounds for plane-side loaded bags, and
- ❖ 60 pounds for heavy checked bags

(7) Certificate holders that only use the standard Advisory Circular 120-27 (as revised) average weights and ratios listed in Table 1 and/or Table 2, as applicable, and do not allow carry-on bags onboard the aircraft, must comply with the following criteria:

- ❖ a 50/50 male/female ratio for summer/winter passenger weights 184/189 pounds,
- ❖ 20 pounds for plane-side loaded bags,
- ❖ 30 pounds for checked bags, and
- ❖ 60 pounds for heavy checked bags.

(8) A Heavy Bag Program is required for all certificate holders using average and/or segmented weights and such programs must meet the following requirements:

(a) If the Heavy Bag Program uses the standard AC weights, the following applies:

- (i) Any checked bag in excess of 50 pounds is considered to weigh 60 pounds;
- (ii) Any checked bag in excess of 100 pounds is shipped as freight (actual weight); and

(iii) Requires that the certificate holder validate (survey) the checked, plane-side loaded, and heavy baggage weights if the certificate holder uses standard AC average weights for these items and changes the 50 lb or 100 pound limits specified in 8(a)(i) or 8(a)(ii).

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(b) If the certificate holder does not have a heavy bag program, the certificate holder must use actual weights for all bags in excess of 50 lb.

(c) If actual or AC weights are used, enter N/A in the “expiration cell” in Table 1 and/or Table 2, as applicable, under Heavy Baggage Weight.

c. Operations specification A096, or one or more of the following operations specifications A097, A098, and/or A099, as applicable, are required for passenger-carrying and all-cargo aircraft.

d. The certificate holder is authorized to use the area/route-specific weight combinations listed in Table 2 for small cabin aircraft (certificated for 5-29 passenger seats). If Table 2 is not applicable, enter N/A in each of its cells:

**Table 2. City Pairs – Small Cabin Aircraft (5-29 Seats)**

City Pairs		M/F	Passenger Weight			Carry-On/Personal Item Weight			Checked Baggage Weight			Plane-Side-Loaded Baggage Weight			Heavy Baggage Weight		
Dept. City	Arr. City	Ratio	Auth.	S/W Wt.	Exp. Yr/Mo	Auth.	Wt.	Exp. Yr/Mo	Auth.	Wt.	Exp. Yr/Mo	Auth.	Wt.	Exp. Yr/Mo	Auth.	Wt.	Exp. Yr/Mo
TABL18	TABL19	TABL20	TABL21	TABL22	TABL23	TABL24	TABL25	TABL26	TABL27	TABL28	TABL29	TABL30	TABL31	TABL32	TABL33	TABL34	TABL35

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1. Issued by the Federal Aviation Administration.
2. These Operations Specifications are approved by direction of the Administrator.

3. Date Approval is effective: \_\_\_\_\_ Amendment Number: \_\_\_\_\_
4. I hereby accept and receive the Operations Specifications in this paragraph.

Date: \_\_\_\_\_