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WEIGHT AND BALANCE

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SECTION 6
WEIGHT AND BALANCE

6.1 GENERAL

In order to achieve the performance and flying characteristics which are designed into the airplane, it must be flown with the weight and center of gravity (C.G.) position within the approved operating range (envelope). Although the airplane offers flexibility of loading, it cannot be flown with the maximum number of adult passengers, full fuel tanks and maximum baggage. With the flexibility comes responsibility. The pilot must ensure that the airplane is loaded within the loading envelope before he makes a takeoff.

Misloading carries consequences for any aircraft. An overloaded airplane will not take off, climb or cruise as well as a properly loaded one. The heavier the airplane is loaded, the less climb performance it will have.

Center of gravity is a determining factor in flight characteristics. If the C.G. is too far forward in any airplane, it may be difficult to rotate for takeoff or landing. If the C.G. is too far aft, the airplane may rotate prematurely on takeoff or tend to pitch up during climb. Longitudinal stability will be reduced. This can lead to inadvertent stalls and even spins; and spin recovery becomes more difficult as the center of gravity moves aft of the approved limit.

A properly loaded airplane, however, will perform as intended. This airplane is designed to provide performance within the flight envelope. Before the airplane is delivered, it is weighed, and a basic empty weight and C.G. location is computed (basic empty weight consists of the standard empty weight of the airplane plus the optional equipment). Using the basic empty weight and C.G. location, the pilot can determine the weight and C.G. position for the loaded airplane by computing the total weight and moment and then determining whether they are within the approved envelope.

6.1 GENERAL (continued)

The basic empty weight and C.G. location are recorded in the Weight and Balance Data Form (Figure 6-5) and the Weight and Balance Record (Figure 6-7). The current values should always be used. Whenever new equipment is added or any modification work is done, the mechanic responsible for the work is required to compute a new basic empty weight and C.G. position and to write these in the Aircraft Log Book and the Weight and Balance Record. The owner should make sure that it is done.

A weight and balance calculation is necessary in determining how much fuel or baggage can be boarded so as to keep within allowable limits. Check calculations prior to adding fuel to ensure against overloading.

The following pages are forms used in weighing an airplane in production and in computing basic empty weight, C.G. position, and useful load. Note that the useful load includes usable fuel, baggage, cargo and passengers.

6.3 AIRPLANE WEIGHING PROCEDURE

Piper provides basic empty weight and center of gravity location for each airplane, when initial airworthiness is issued.

This data is provided on a **Weight and Balance Data Form (Figure 6-5) in Section 6 of the POH.**

The removal or addition of equipment or airplane modifications can affect the basic empty weight and center of gravity. The following is a weighing procedure to determine this basic empty weight and center of gravity location:

(a) Preparation

- (1) Be certain that all items checked in the airplane equipment list are installed in the proper location in the airplane.
- (2) Remove excessive dirt, grease, moisture, and foreign items such as rags and tools, from the airplane before weighing.
- (3) Defuel airplane. Then open all fuel drains until all remaining fuel is drained. Operate each engine until all undrainable fuel is used and engine stops. Then add the unusable fuel (2.0 gallons total. 1.0 gallon each wing).

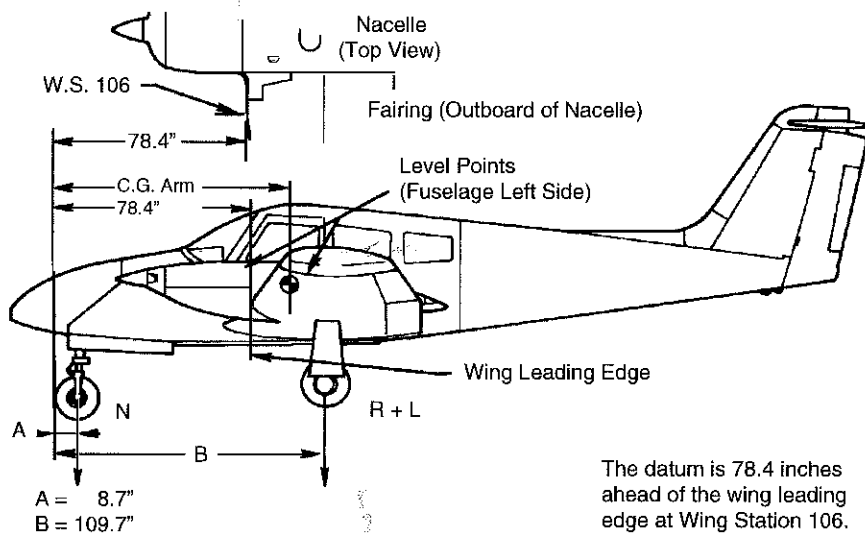
6.3 AIRPLANE WEIGHING PROCEDURE (continued)**CAUTION**

Whenever the fuel system is completely drained and fuel is replenished it will be necessary to run the engines for a minimum of 3 minutes at 1000 RPM on each tank to ensure no air exists in the fuel supply lines.

- (4) Fill with oil to full capacity.
 - (5) Place pilot and copilot seats in fourth (4th) notch, aft of forward position. Put flaps in the fully retracted position and all control surfaces in the neutral position. Tow bar should be in the proper location and entrance and baggage door closed.
 - (6) Weigh the airplane inside a closed building to prevent errors in scale readings due to wind.
- (b) Leveling
- (1) With airplane on scales, block main gear oleo pistons in the fully extended position.
 - (2) Level airplane (refer to Figure 6-3) deflating nose wheel tire, to center bubble on level.
- (c) Weighing- Airplane Basic Empty Weight
- (1) With the airplane level and brakes released, record the weight shown on each scale. Deduct the tare, if any, from each reading.

Scale Position and Symbol	Scale Reading	Tare	Net Weight
Nose Wheel (N)			
Right Main Wheel (R)			
Left Main Wheel (L)			
Basic Empty Weight, (as Weighed) (T)			

Weighing Form
 Figure 6-1



Leveling Diagram
 Figure 6-3

6.3 AIRPLANE WEIGHING PROCEDURE (continued)

(d) Basic Empty Weight Center of Gravity

- (1) The Leveling Diagram geometry (Figure 6-3) applies to the PA-44-180 airplane when it is level. Refer to Leveling paragraph 6.3 (b).
- (2) The basic empty weight center of gravity (as weighed including optional equipment, full oil and unusable fuel) can be determined by the following formula:

$$\text{C.G. Arm} = \frac{N(A) + (R + L)(B)}{T} \text{ inches}$$

Where: $T = N + R + L$

6.5 WEIGHT AND BALANCE DATA AND RECORD

The Basic Empty Weight, Center of Gravity Location and Useful Load listed in Figure 6-5 are for the airplane as delivered from the factory. These figures apply only to the specific airplane serial number and registration number shown.

The basic empty weight of the airplane as delivered from the factory has been entered in the Weight and Balance Record (Figure 6-7). This form is provided to present the current status of the airplane basic empty weight and a complete history of previous modifications. Any change to the permanently installed equipment or modification which affects weight or moment must be entered in the Weight and Balance Record.

**SECTION 6
WEIGHT AND BALANCE**

PA-44-180, SEMINOLE

MODEL PA-44-180, SEMINOLE

Airplane Serial Number 4496486
 Registration Number N747DS
 Date 11/15/19

AIRPLANE BASIC EMPTY WEIGHT

Item	Weight (Lbs)	x C.G. Arm (Inches Aft of Datum)	= Moment (In-Lbs)
Standard Empty Weight* Computed ^{Actual}	2647.9	86.4717	228968.5
Optional Equipment	16.4	146.1646	2397.1
Basic Empty Weight	2664.3	86.8392	231365.6

*The standard empty weight includes full oil capacity and 2.0 gallons of unusable fuel.

AIRPLANE USEFUL LOAD - NORMAL CATEGORY OPERATION

$$\begin{aligned}
 &(\text{Gross Weight}) - (\text{Basic Empty Weight}) = \text{Useful Load} \\
 &(3800 \text{ lbs.}) - (2664.3 \text{ lbs.}) = 1135.7 \text{ lbs.}
 \end{aligned}$$

THIS BASIC EMPTY WEIGHT, C.G. AND USEFUL LOAD ARE FOR THE AIRPLANE AS CERTIFIED AT THE FACTORY. REFER TO APPROPRIATE AIRCRAFT RECORD WHEN ALTERATIONS HAVE BEEN MADE

Weight and Balance Data Form
 Figure 6-5

PA-44-180	Serial Number	4496486	Registration Number N747DS			Page Number		
			Wt. (Lb.)	Arm (In.)	Moment /100	Running Basic Empty Weight	Moment /100	
Date	Item No.	Description of Article or Modification	Added (+) Removed (-)	Wt. (Lb.)	Arm (In.)	Moment /100	Running Basic Empty Weight	Moment /100
11/15/19		As Delivered		2664.3				

Weight and Balance Record
Figure 6-7

**SECTION 6
WEIGHT AND BALANCE**

PA-44-180, SEMINOLE

PA-44-180	Serial Number	Description of Article or Modification	Added (+) Removed (-)	Registration Number			Page Number				
				Item No.	Date	Wt. (Lb.)	Arm (In.)	Moment /100	Running Basic Empty Weight	Wt. (Lb.)	Moment /100

Weight and Balance Record (continued)
Figure 6-7 (continued)

6.7 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT

- (a) Add the weight of all items to be loaded to the basic empty weight.
- (b) Use the Loading Graph (Figure 6-13) to determine the moment of all items to be carried in the airplane.
- (c) Add the moment of all items to be loaded to the basic empty weight moment.
- (d) Divide the total moment by the total weight to determine the C.G. location.
- (e) By using the figures of item (a) and item (d) (above), locate a point on the C.G. range and weight graph (Figure 6-15). If the point falls within the C.G. envelope, the loading meets the weight and balance requirements.

6.7 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT
(continued)

	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight			
Pilot and Front Passenger	340.0	80.5	27370
Passengers (Rear Seats)	340.0	118.1	40154
Fuel (108 Gallon Maximum Usable)		95.0	
Baggage (200 Lb. Limit)		142.8	
Ramp Weight (3816 Lbs. Max.)			
Fuel Allowance for Engine Start, Taxi & Runup	-16.0	95.0	-1520
Take-off Weight (3800 Lbs. Max.)			

The center of gravity (C.G.) for the take-off weight of this sample loading problem is at _____ inches aft of the datum line. Locate this point (_____) on the C.G. range and weight graph. Since this point falls within the weight - C.G. envelope, this loading meets the weight and balance requirements.

Take-off Weight			
Minus Estimated Fuel Burn-off (climb & cruise) @ 6.0 Lbs/Gal.		95.0	
Landing Weight			

Locate the center of gravity of the landing weight on the C.G. range and weight graph. Since this point falls within the weight- C.G. envelope, the loading may be assumed acceptable for landing.

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO ENSURE THAT THE AIRPLANE IS LOADED PROPERLY AT ALL TIMES.

Sample Loading Problem
 Figure 6-9

6.7 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT
(continued)

	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight			
Pilot and Front Passenger		80.5	
Passengers (Rear Seats)		118.1	
Fuel (108 Gallon Maximum Usable)		95.0	
Baggage (200 Lb. Limit)		142.8	
Ramp Weight (3816 Lbs. Max.)			
Fuel Allowance for Engine Start, Taxi & Runup	-16.0	95.0	-1520
Take-off Weight (3800 Lbs. Max.)			

The center of gravity (C.G.) for the take-off weight of this loading problem is at _____ inches aft of the datum line. Locate this point () on the C.G. range and weight graph. If this point falls within the weight - C.G. envelope, this loading meets the weight and balance requirements.

Take-off Weight			
Minus Estimated Fuel Burn-off (climb & cruise) @ 6.0 Lbs/Gal.		95.0	
Landing Weight			

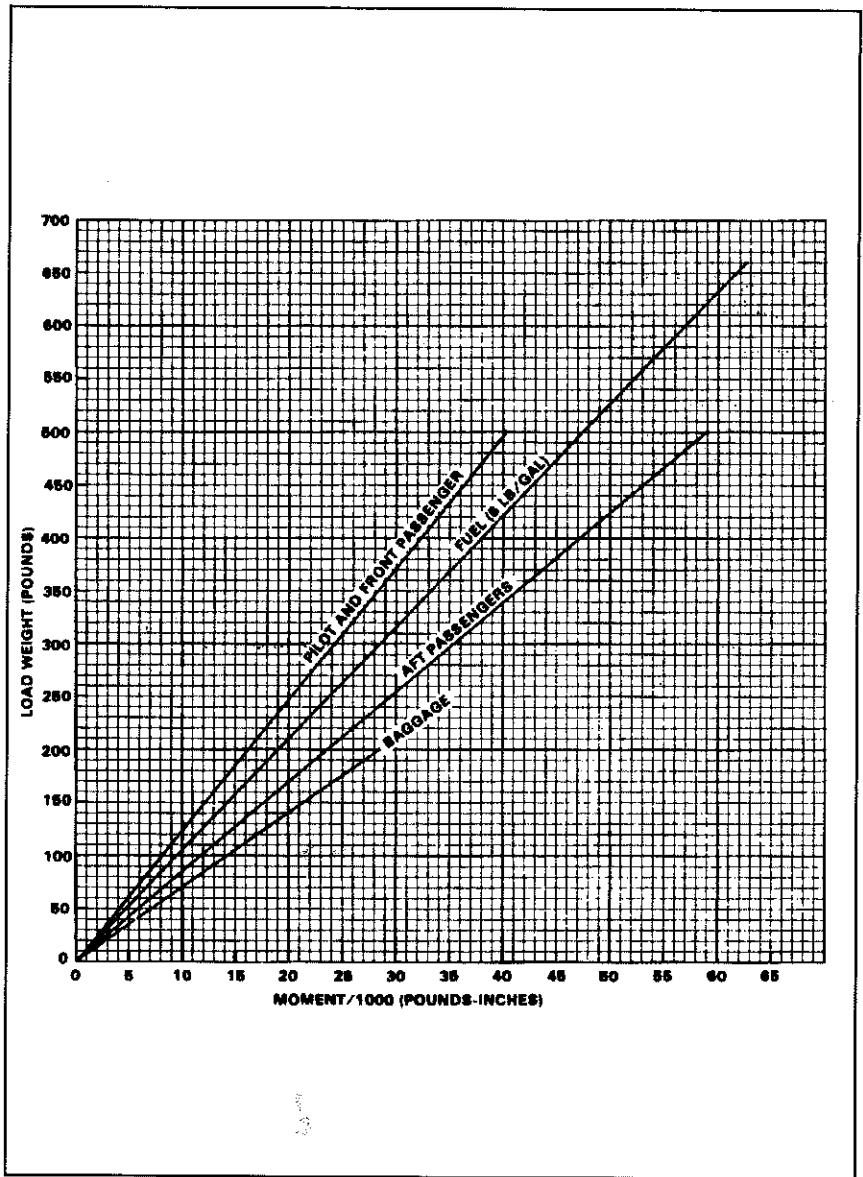
Locate the center of gravity of the landing weight on the C.G. range and weight graph. If this point falls within the weight- C.G. envelope, the loading may be assumed acceptable for landing.

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO ENSURE THAT THE AIRPLANE IS LOADED PROPERLY AT ALL TIMES.

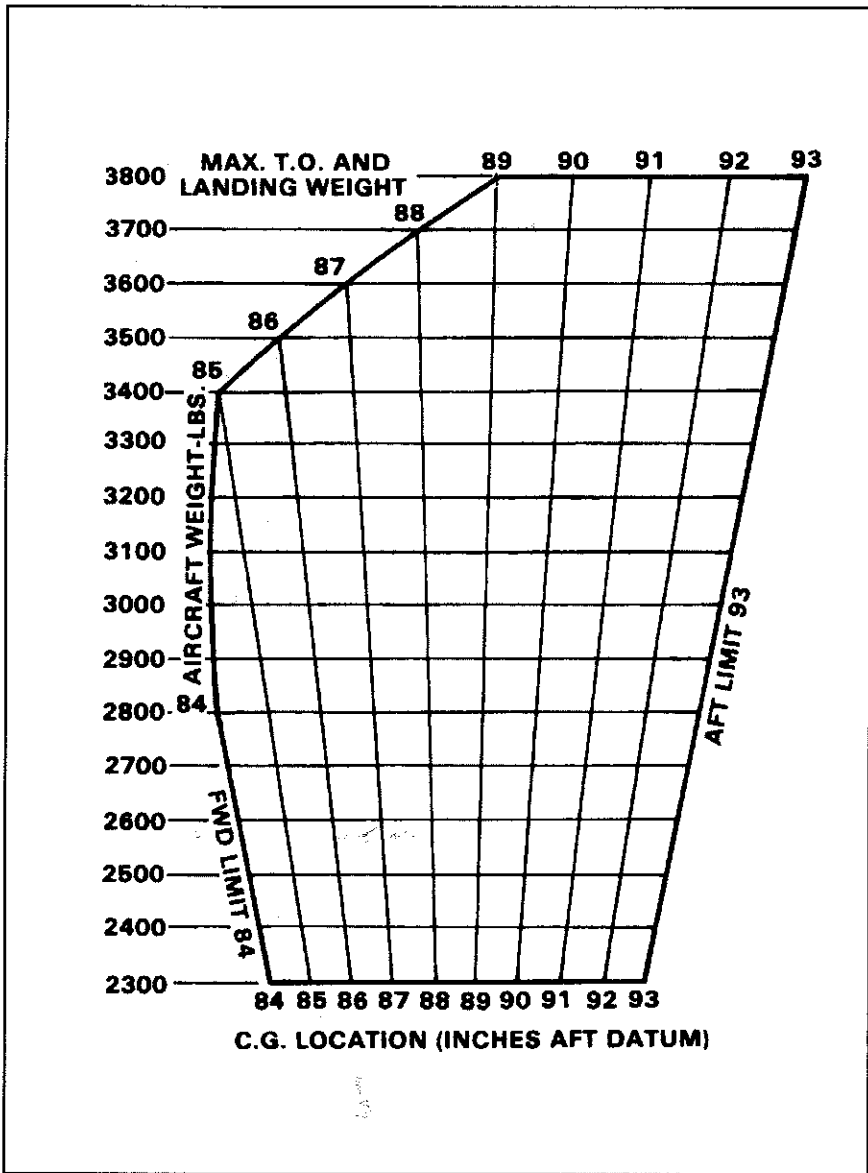
Weight and Balance Loading Form

Figure 6-11

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Loading Graph
Figure 6-13



C.G. Range and Weight
Figure 6-15