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WEIGHT AND BALANCE

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\*For 1982 and preceding models.  
\*\*For 1983 and subsequent models.

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 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. Before the airplane is licensed, 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 easily 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.

The basic empty weight and C.G. location are recorded in the Weight and Balance Data Form (Figure 6-7) and the Weight and Balance Record (Figure 6-9). 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 and still remain within allowable limits. Check calculations prior to adding fuel to insure against improper loading.

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. Following this is the method for computing takeoff weight and C.G.

### 6.3 AIRPLANE WEIGHING PROCEDURE

At the time of licensing, Piper Aircraft Corporation provides each airplane with the basic empty weight and center of gravity location. This data is supplied by Figure 6-7.

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, 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 engine on each tank until all undrainable fuel is used and engine stops.

- (4) Fill to full capacity with oil and operating fluids.
- (5) Place pilot and copilot seats in a center position on the seat tracks. Put flaps in the fully retracted position and all control surfaces in the neutral position. Tow bar should be in the proper location and all doors closed.
- (6) Weigh the airplane inside a closed building to prevent errors in scale readings due to wind.

(b) Leveling

Level the airplane (refer to Figure 6-3) deflating the 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.

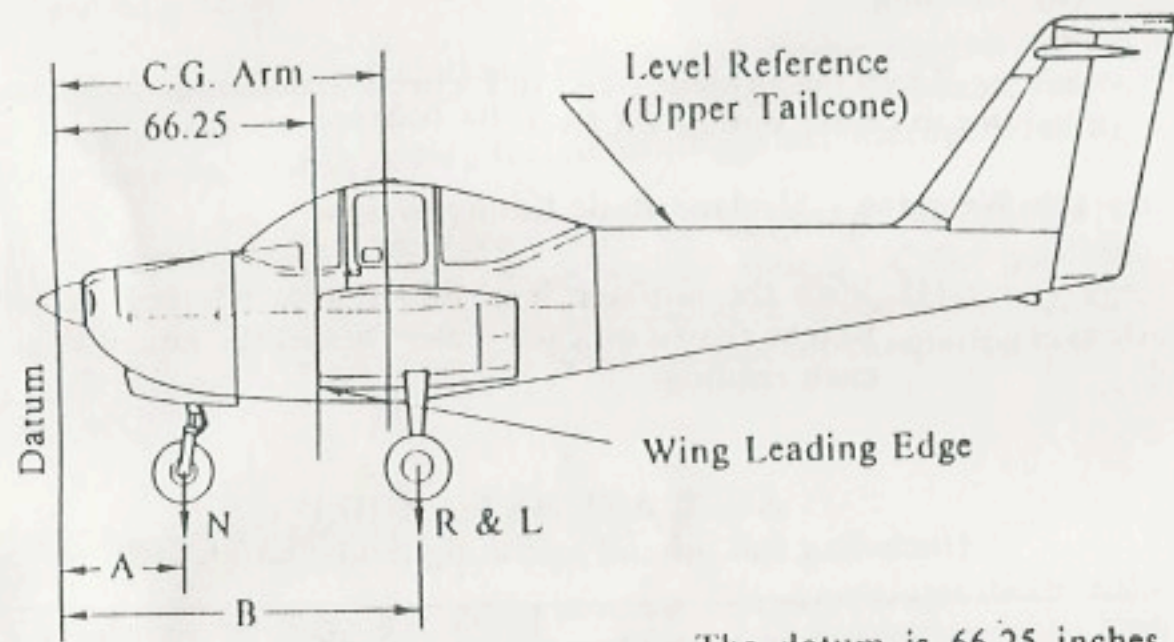
AIRPLANE AS WEIGHED  
(Including full oil and operating fluids but no fuel)

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

WEIGHING FORM  
Figure 6-1

(d) Center of Gravity

(1) The following geometry applies to the PA-38-112 airplane when it is level. Refer to Leveling paragraph 6.3 (b).



A = 33.0  
B = 90.0

The datum is 66.25 inches ahead of the wing leading edge.

LEVELING DIAGRAM  
Figure 6-3

(2) The empty weight center of gravity (as weighed including optional equipment, full oil and operating fluids) can be determined by the following formula:

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

Where:  $T = N + R + L$

(c) Basic Empty Weight

Item	Weight (Lbs)	Arm (Inches Alt of Datum)	Moment (Lb-In.)
Weight (as Weighed)			
Unusable Fuel (2 gal.)	12.0	75.4	905
Basic Empty Weight			

BASIC EMPTY WEIGHT  
Figure 6-5

6.5 WEIGHT AND BALANCE DATA AND RECORD

The Basic Empty Weight, Center of Gravity Location and Useful Load listed in Figure 6-7 are for the airplane as licensed at the factory. These figures apply only to the specific airplane serial number and registration number shown.

The basic empty weight of the airplane as licensed at the factory has been entered in the Weight and Balance Record (Figure 6-9). 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.

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SECTION 6  
WEIGHT AND BALANCE

PIPER AIRCRAFT CORPORATION  
PA-38-112, TOMAHAWK

MODEL PA-38-112 TOMAHAWK

Airplane Serial Number \_\_\_\_\_

Registration Number \_\_\_\_\_

Date \_\_\_\_\_

AIRPLANE BASIC EMPTY WEIGHT

Item	Weight (Lbs.)	C.G. Arm (Inches Aft of Datum)	Moment (Lb-In.)
Standard Empty Weight*			
Optional Equipment			
Basic Empty Weight			

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

AIRPLANE USEFUL LOAD - NORMAL CATEGORY OPERATION

(Gross Weight) - (Basic Empty Weight) = Useful Load

Normal Category: (1670 lbs.) - (        lbs.) =        lbs.

Utility Category: (1670 lbs.) - (        lbs.) =        lbs.

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

WEIGHT AND BALANCE DATA FORM  
Figure 6-7

Page Number	Running Basic Empty Weight	
	Wt. (Lb.)	Moment 100
Registration Number	Weight Change	
	Wt. (Lb.)	Arm (In.)
	Moment 100	
Serial Number	Added (+)	
	Removed (-)	
PA-38-112	Date	
	Item No.	

WEIGHT AND BALANCE RECORD

Figure 6-9



SECTION 6  
WEIGHT AND BALANCE

PIPER AIRCRAFT CORPORATION  
PA-38-112, TOMAHAWK

2414A	1179	73.829	87045
	Weight (Lbs.)	Arm Aft Datum (Inches)	Moment (Lb-In.)
<del>2467R</del>	<del>1162.89</del>	<del>73.25</del>	<del>85182.82</del>
Basic Empty Weight		85.5	
Pilot and Passenger**		75.4	
Fuel (30 Gallon Maximum) (6 lbs/GAL)		115.0	
Baggage (100 Lbs. Maximum)*			
Total Loaded Airplane			

Totals must be within approved weight and C.G. limits. It is the responsibility of the airplane owner and the pilot to insure that the airplane is loaded properly. The Basic Empty Weight C.G. is noted on the Weight and Balance Data Form (Figure 6-7). If the airplane has been altered, refer to the Weight and Balance Record for this information.

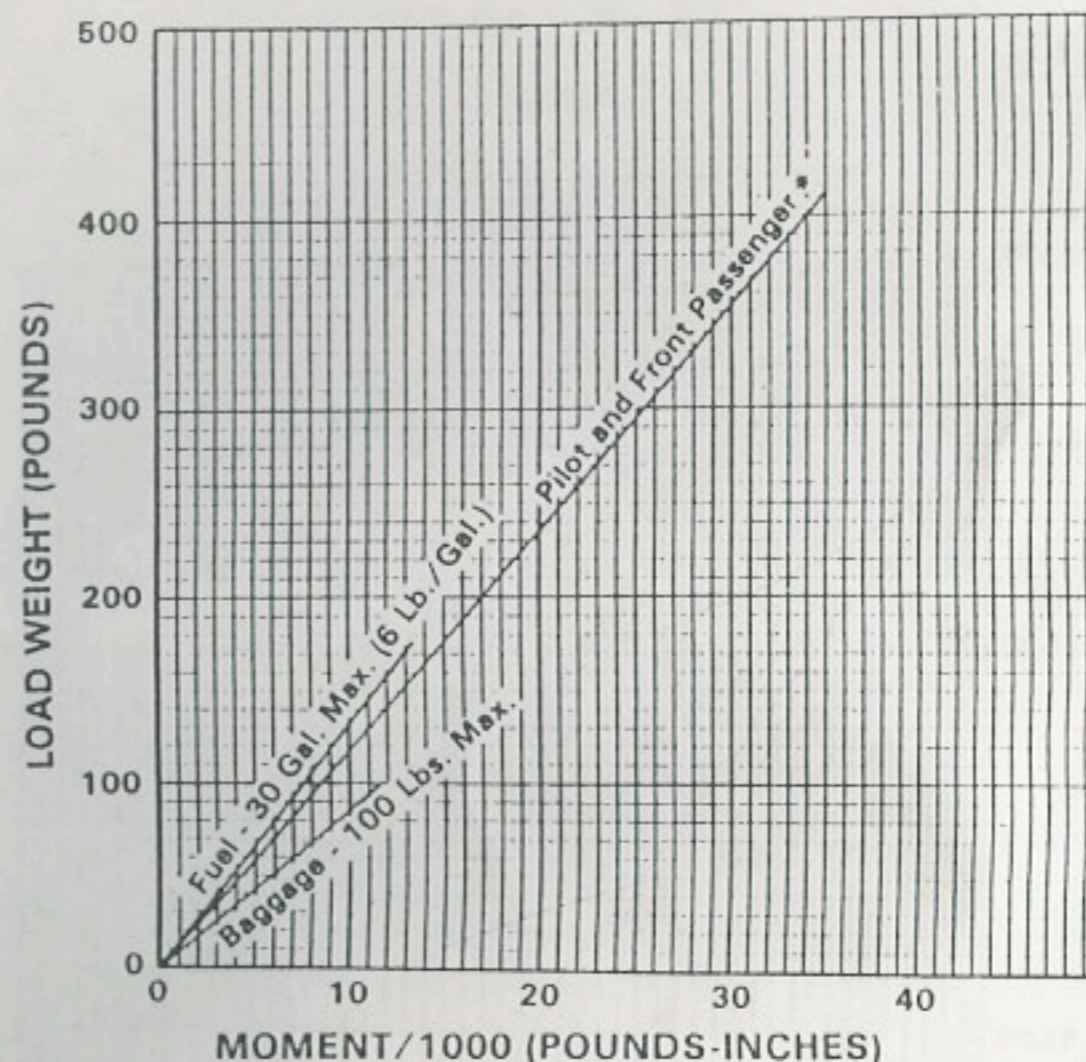
\*No baggage allowed for spins.

\*\*Occupant C.G. is shown with the seats in the fourth notch from the most forward position. For other seat locations and corresponding arm aft datum see Figure 6-14.

WEIGHT AND BALANCE LOADING FORM  
Figure 6-13

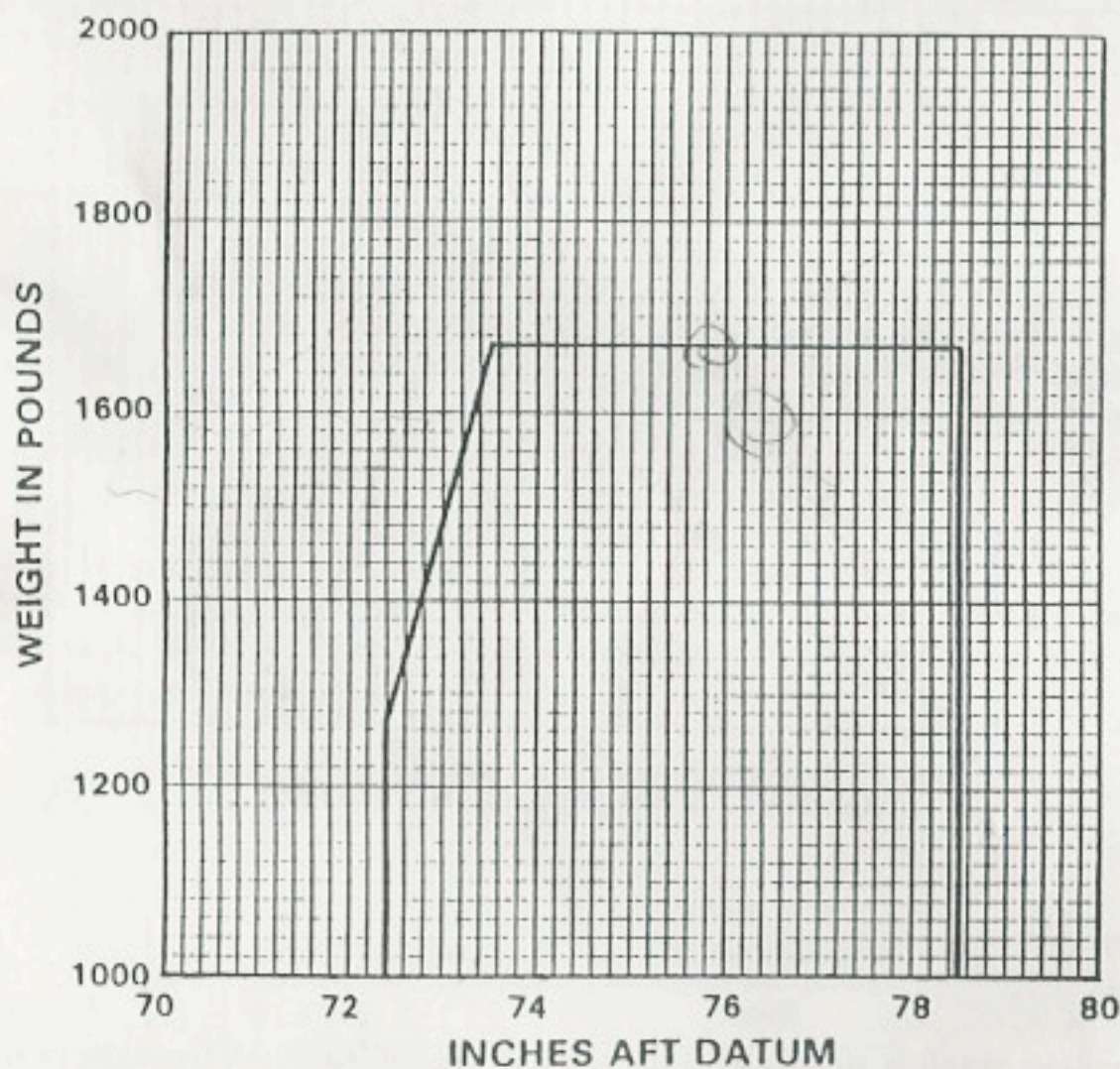
Seat Position	Arm Aft Datum (Inches)
FWD 1	80.8
2	82.3
3	83.9
4	85.5
5	87.5
AFT 6	89.5

SEAT POSITION AND CORRESPONDING ARM AFT DATUM  
Figure 6-14



\*Loading graph is shown with the seats in the fourth notch from the most forward position. If C.G. falls near the forward or aft limit, occupant seat positions are important; and moments should be calculated by multiplying pilot and passenger weight by appropriate arm aft datum (see Figure 6-14), rather than determined by the loading graph.

LOADING GRAPH  
Figure 6-15



C. G. RANGE AND WEIGHT  
Figure 6-17