#### 2.13 CENTER OF GRAVITY LIMITS

Weight	Forward Limit	Rearward Limit	
Pounds	Inches Aft of Datum	Inches Aft of Datum	
3600	91.4	95.0	
3200	- 83.5	95.0	
2400 (and less)	78.0	95.0	

#### NOTES

Straight line variation between points given.

The datum used is 78.4 inches ahead of the wing leading edge at the intersection of the untapered and inboard tapered section.

It is the responsibility of the airplane owner and the pilot to insure that the airplane is properly loaded. See Section 6 (Weight and Balance) for proper loading instructions.

#### 2.15 MANEUVER LIMITS

No acrobatic maneuvers including spins approved.

#### 2.17 FLIGHT LOAD FACTORS

(a)	Positive Load Factor (Maximum)	3.8 G
(b)	Negative Load Factor (Maximum) N	lo inverted maneuvers
		approved
(c)	Positive Load Factor - Flaps Down (Maximum)	2.0 G
(d)	Negative Load Factor - Flaps Down (Maximum)	No inverted
		maneuvers approved

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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. 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 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.

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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 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 provides each airplane with the basic empty weight and center of gravity location. This data is supplied by Figure 6-5.

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 engine on each tank until all undrainable fuel is used and engine stops. Then add the unusable fuel (5 gallons total, 2.5 gallons each wing).

#### 6.7 GENERAL LOADING RECOMMENDATIONS

The following general loading recommendation is intended only as a guide. The charts, graphs and instructions should be checked to assure that the airplane is within the allowable weight vs. center of gravity envelope.

(a) Pilot Only

Load rear baggage compartment to capacity first. Without aft baggage, fuel load may be limited by forward envelope for some combinations of optional equipment.

- (b) 2 Occupants Pilot and Passenger in Front Load rear baggage compartment first. Without aft baggage, fuel load may be limited by fwd. envelope for some combinations of optional equipment.
- (c) 3 Occupants 2 in front, 1 in middle Load rear baggage compartment to capacity first. Baggage in nose may be limited by fwd. envelope. Without aft baggage, fuel may be limited by fwd. envelope for some combinations of optional equipment.
- (d) 4 Occupants 2 in front, 1 in middle, 1 in rear
  Load rear baggage compartment first. Baggage in nose may be limited by fwd. envelope. Without aft baggage, fuel may be limited by fwd. envelope for some combinations of optional equipment.
- (e) 5 Occupants 2 in front, 1 in middle, 2 in rear With five occupants, the aft passengers weight, fuel and baggage may be limited by envelope. Note Placard if installed. Investigation is required to determine optimum loading for baggage.

## OPTIONAL SIX SEAT CONFIGURATION

- (d) 4 Occupants 2 in front, 2 in middle Load rear baggage compartment to capacity first. Baggage in nose may be limited by forward envelope. Without aft baggage, fuel may be limited by fwd. envelope for some combinations of optional equipment.
- (e) 5 Occupants 2 in front, 2 in middle, 1 in rear Investigation is required to determine optimum loading for baggage.

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#### 6.7 GENERAL LOADING RECOMMENDATIONS (CONT'D)

OPTIONAL SIX SEAT CONFIGURATION (Cont'd)

- (e) 5 Occupants 1 in front, 2 in middle, 2 in rear Load forward baggage compartment to capacity first. Aft baggage and/or fuel load may be limited by aft envelope.
- (f) 6 Occupants 2 in front, 2 in middle, 2 in rear With six occupants, the aft passengers weight, fuel and baggage may be limited by envelope. Investigation is required to determine optimum location for baggage. Note placard if installed.

For all airplane configurations, it is the responsibility of the pilot in command to make sure that the airplane always remains within the allowable weight vs. center of gravity while in flight.

## 6.9 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.

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	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight			
Pilot and Front Passenger		85.5	
Passengers (Center Seats)			
(Aft Facing)		119.1	
Passengers (Rear Seats)		157.6	
Fuel (102 Gallon Maximum)		94.0	
Baggage (Forward) (100 Lb. Limit)		42.0	
Baggage (Aft) (100 Lb. Limit)		178.7	
Ramp Weight (3615 Lbs. Max.)			
Fuel Allowance for Engine			
Start, Taxi & Runup	-15.0	94.0	-1410
Take-off Weight (3600 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. 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.	94.0	
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 INSURE THAT THE AIRPLANE IS LOADED PROPERLY AT ALL TIMES.

# WEIGHT AND BALANCE LOADING FORM (NORMAL CATEGORY)

Figure 6-11

## SECTION 6 WEIGHT AND BALANCE

## PA-32R-301T, SARATOGA II TC



C.G. RANGE AND WEIGHT Figure 6-15

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