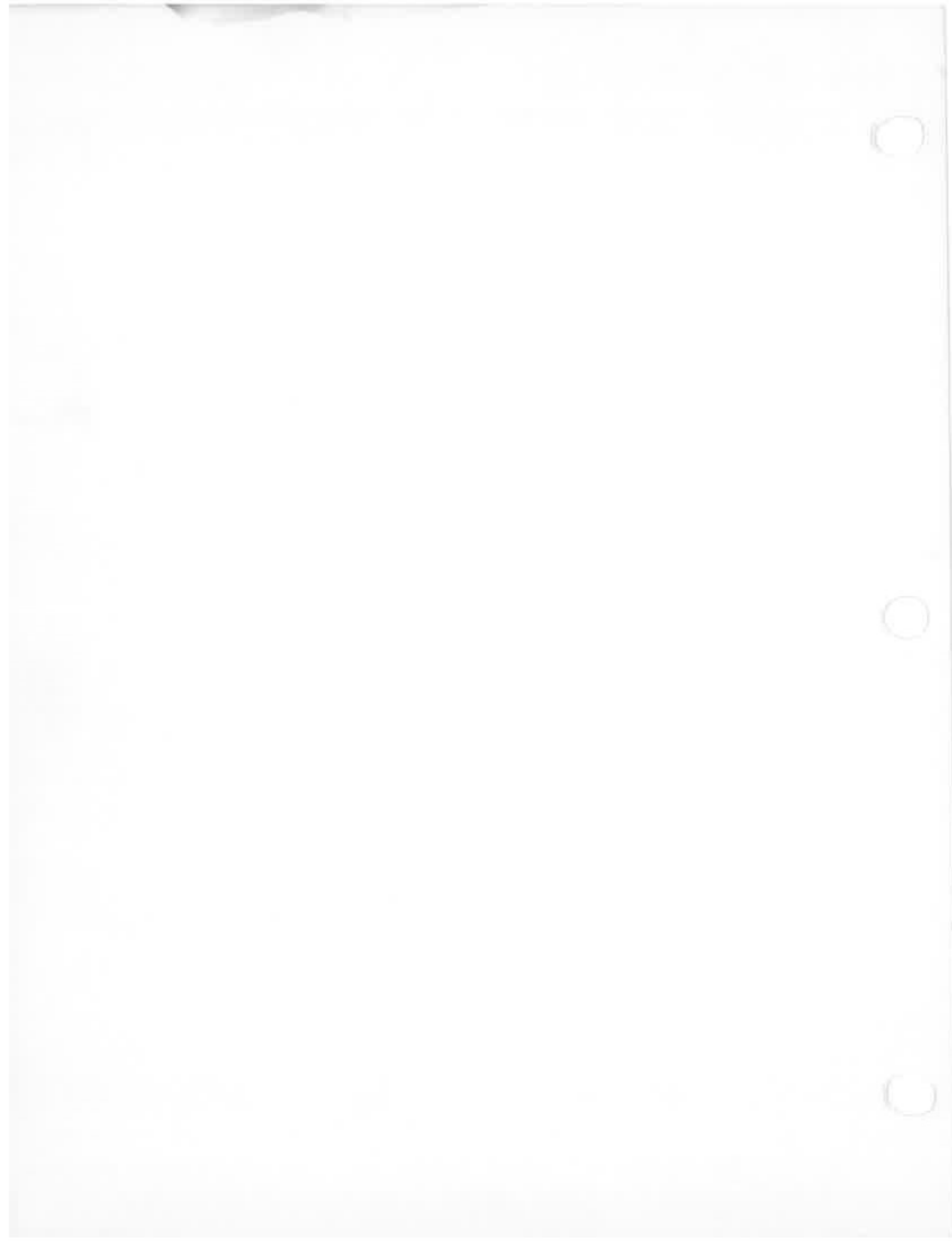


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## SECTION 6

### 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 insure 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 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 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 6-5) 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.

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### 6.3 AIRPLANE WEIGHING PROCEDURE

At the time of delivery, Piper Aircraft Corporation 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, 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 (2.0 gallons total, 1.0 gallons each wing).

CAUTION

Whenever the fuel system is completely drained and fuel is replenished, it will be necessary to run the engine for a minimum of three minutes at 1000 RPM on each tank to insure 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 all entrance and baggage doors 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.

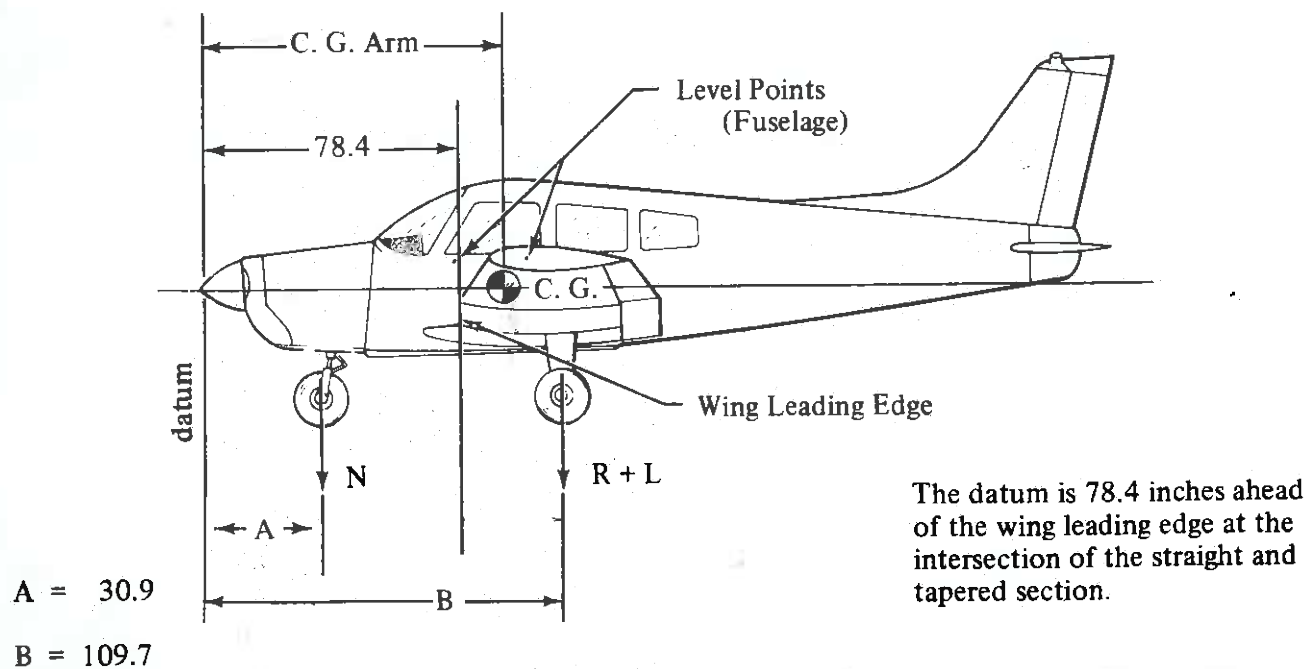
Scale Position and Symbol	Scale Reading	Tare	Net Weight
Nose Wheel (N)			
Right Main Wheel (R)			
Left Main Wheel (L)			
Basic Empty Weight, as Weighed (T)	—	—	

WEIGHING FORM

Figure 6-1

(d) Basic Empty Weight Center of Gravity

- (1) The following geometry applies to the PA-28-161 airplane when it is level. Refer to Leveling paragraph 6.3 (b).



LEVELING DIAGRAM

Figure 6-3

- (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.

MODEL PA-28-161 CHEROKEE WARRIOR II

Airplane Serial Number 28-8016311  
Registration Number N81916  
Date 3-17-80

AIRPLANE BASIC EMPTY WEIGHT

Item	Weight (Lbs)	x	C. G. Arm (Inches Aft of Datum)	= Moment (In-Lbs)
Standard Empty Weight* <del>AKKX</del> Computed	1353.0		85.4	115499
Optional Equipment	115.4		102.3	11800
Basic Empty Weight	1468.4		86.7	127299

\*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: (2325 lbs) - (1468.4lbs) = 856.6 lbs.

Utility Category: (1950 lbs) - (1468.4lbs) = 481.6lbs.

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

REVISED WT & C.G.  
SEE ATTACHED SHEETS

Y-37-81 *Rick Smith* INSPECTOR  
DATE CRS2023 LOUISIANA AIRCRAFT INC.

WEIGHT AND BALANCE DATA FORM

Figure 6-5

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WEIGHT AND BALANCE**

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## WEIGHT AND BALANCE RECORD

Figure 6-7

**PIPER AIRCRAFT CORPORATION  
PA-28-161, CHEROKEE WARRIOR II**

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Figure 6-7 (cont)



## 6.7 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT

- Add the weight of all items to be loaded to the basic empty weight.
- Use the Loading Graph (Figure 6-13) to determine the moment of all items to be carried in the airplane.
- Add the moment of all items to be loaded to the basic empty weight moment.
- Divide the total moment by the total weight to determine the C.G. location.
- 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.

2272

	Weight (Lbs)	Arm Aft Datum (Inches)	$\div 100$ Moment (In-Lbs)
Basic Empty Weight	<del>1477.7</del> <del>1453.3</del>	86.4	<del>1277</del> <del>125702</del>
Pilot and Front Passenger	340.0	80.5	27370
Passengers (Rear Seats)*	340.0	118.1	40154
Fuel (48 Gallon Maximum)	191.5	95.0	18193
Baggage*		142.8	
Total Loaded Airplane	2325	90.9	211419

The center of gravity (C.G.) of this sample loading problem is at 90.9 inches aft of the datum line. Locate this point ( 90.9 ) 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.

✕ IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO INSURE THAT THE AIRPLANE IS LOADED PROPERLY.

\*Utility Category Operation - No baggage or aft passengers allowed.

### SAMPLE LOADING PROBLEM (NORMAL CATEGORY)

Figure 6-9

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WEIGHT AND BALANCE

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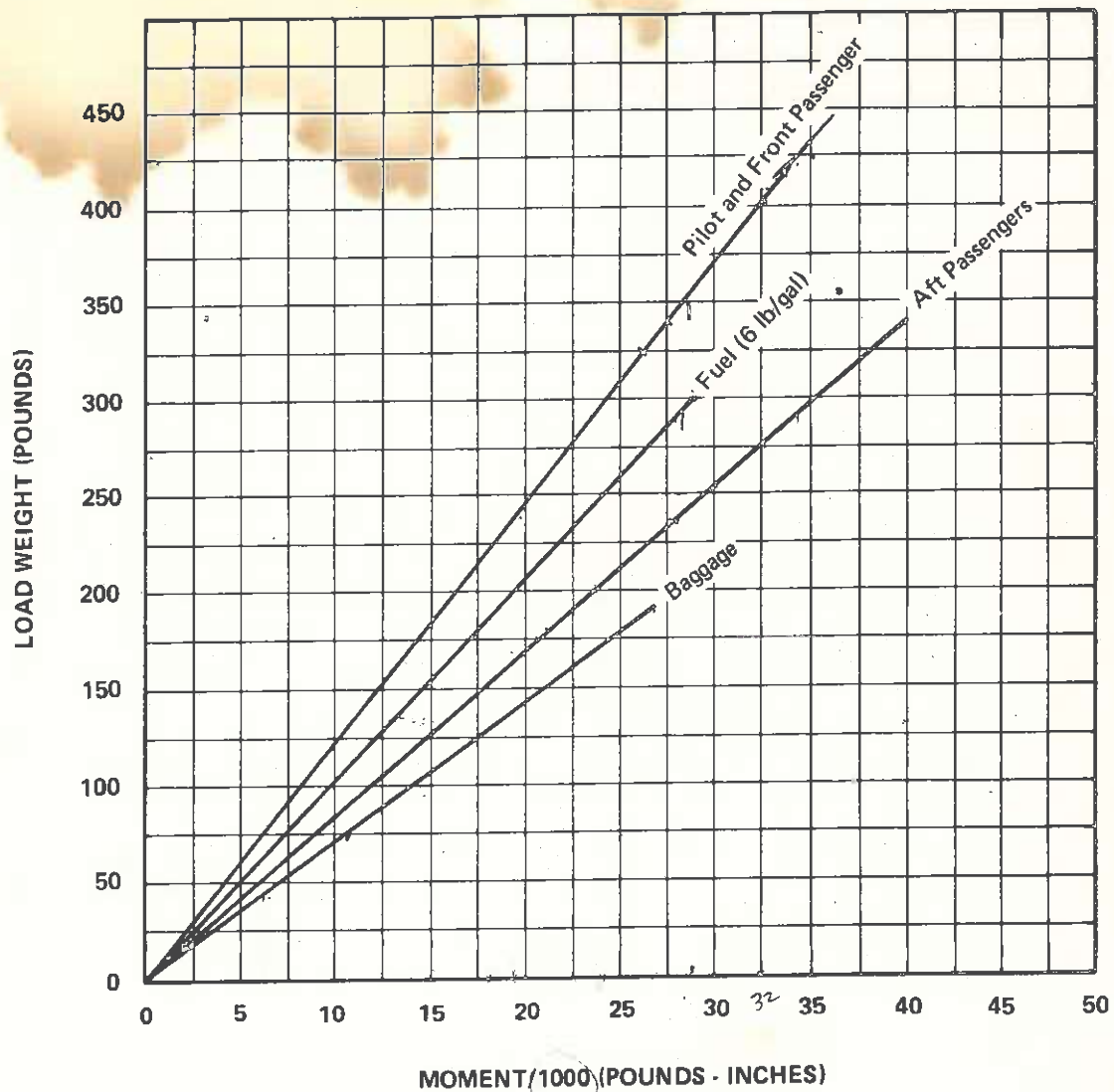
	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight	1472.2	86.30	127048
Pilot and Front Passenger	400	80.5	
Passenger (Rear Seats)*	0	118.1	
Fuel (48 Gallon Maximum)		95.0	
Baggage*	30	142.8	
Total Loaded Airplane			

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 6-5). If the airplane has been altered, refer to the Weight and Balance Record for this information.

\*Utility Category Operation - No baggage or aft passengers allowed.

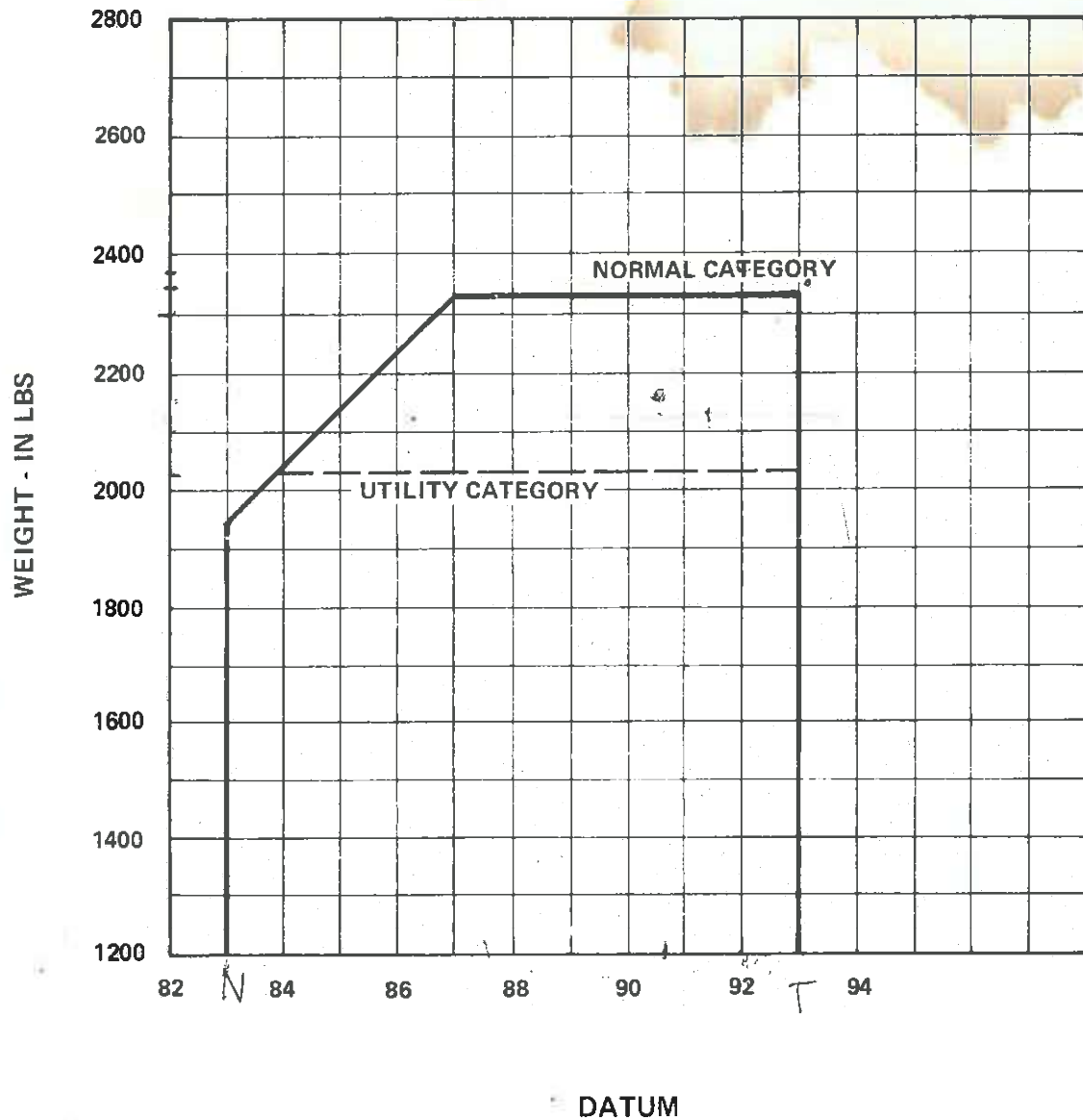
WEIGHT AND BALANCE LOADING FORM

Figure 6-11



LOADING GRAPH

Figure 6-13



C. G. RANGE AND WEIGHT

Figure 6-15

2348  
222  
222

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## 6.9 EQUIPMENT LIST

The following is a list of equipment which may be installed in the PA-28-161. It consists of those items used for defining the configuration of an airplane when the basic empty weight is established at the time of licensing. Only those standard items which are alternate standard items and those required to be listed by the certificating authority (FAA) are presented. Items marked with an "X" are those items which were installed on the airplane described below when licensed by the manufacturer.

Where the letter "A," "B," or "C" precedes an item, "A" denotes an item which is required equipment that must be installed in the aircraft; "B" denotes an item which is required equipment that must be installed in the aircraft unless replaced by an optional equivalent item; "C" denotes an optional item which replaces a required item of standard equipment. Where no letter precedes an item, that item is not required equipment.

Unless otherwise indicated, the installation certification basis for the equipment included in this list is the aircraft's approved type design.

PIPER AIRCRAFT CORPORATION

PA-28-161 WARRIOR II

SERIAL NO. \_\_\_\_\_ REGISTRATION NO. \_\_\_\_\_ DATE: \_\_\_\_\_

### (a) Propeller and Propeller Accessories

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
1 A	Propeller, Sensenich 74DM6-0-60 Cert. Basis - TC P886		32.4	3.8	123
3	Spinner Dome and Bulkhead Piper Dwg. 35323 or 36850		2.9	3.8	11
4	Spinner Dome and Bulkhead Piper Dwg. 87325		3.3	3.8	13

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(b) Engine and Engine Accessories

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
5	A Engine				
	a. Lycoming Model O-320-D2A	_____	272.0	21.3	5794
	b. Lycoming Model O-320-D3G	_____	268.0	21.3	5708
	Cert. Basis - TC 274				
7	B Alternator 60 Amp				
	a. Prestolite No. ALY6422				
	Piper Dwg. 99981-0	_____	10.5	14.0	147
	b. Chrysler 3656624				
	Piper Dwg. 99945-0	_____	12.4	14.0	174
	c. Chrysler 4111810				
	Piper Dwg. 99945-3	_____	13.5	14.0	189
9	A Engine Driven Fuel Pump				
	Lycoming Dwg. 75246				
	Cert. Basis - TC E274		1.7	36.3	62
10	A Electric Fuel Pump				
	Bendix P/N 478360		1.8	36.8	66
11	A Fuel Valve				
	Piper Dwg. 66945 or Allen				
	Aircraft Prod. Inc. No. 6S122	_____	0.4	61.9	25
12	A Oil Coolers				
	Piper Dwg. 18622				
	Harrison No. C8526250		1.9	41.3	78
13	A Air Filter				
	Piper Dwg. 35477		0.9	29.5	27
14	A Starter				
	<del>Prestolite MZ4218</del> SKYTEC		<del>17.0</del>	14.5	<del>247</del>
	<del>Cert. Basis - TC E274</del> STC-5700218 NY		8.0	14.5	116.5
15	A Oil Filter				
	LW-13743 (Champion No.				
	CH48110) or Lyc. No. 75528				
	(AC No. OF5578770)				
	Cert. Basis - TC E274		**2.5	35.3	89

\*Included in engine weight.

\*\*Includes adapter.

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(c) Landing Gear and Brakes

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
16 A	Two Main Wheel Assemblies				
	a. Cleveland Aircraft Products	<u>X</u>	32.3	109.6	3540
	Wheel Assy. No. 40-86				
	Brake Assy. No. 30-55				
	Cert. Basis - TSO C26a				
	b. 6.00-6 Type III 4 Ply				
	Rating Tires with Regular Tubes				
	Cert. Basis - TSO C62				
17 A	Nose Wheel Assembly				
	a. Cleveland Aircraft Products	<u>X</u>			
	Wheel Assy. No. 40-77A		2.6	30.8	80
	Cert. Basis - TSO C26a				
	b. McCauley Industrial Corp.				
	Wheel Assy. No. D-30500		3.6	30.8	111
	Cert. Basis - TSO C26b				
	c. 5.00-5 Type III 4 Ply	<u>X</u>			
	Rating Tire with Regular Tube		5.8	30.8	179
	Cert. Basis - TSO C62				
18 A	Hand Brake Master Cylinder				
	Piper Dwg. 65842	<u>X</u>			
	(Cleveland Aircraft Products		0.6	60.9	37
	P/N 10-22)				
19 A	Toe Brake Cylinders				
	a. Cleveland Aircraft Products				
	No. 10-27		0.7	53.0	37
	b. Gar-Kenyon Instrument	<u>X</u>			
	No. 17000		0.4	53.0	21

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(d) Electrical Equipment

Item No.		Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
20	A	Voltage Regulator Piper Dwg. 68804-3	<input checked="" type="checkbox"/>	0.9	51.9	47
21	B	Battery Piper Dwg. 35544 (Rebat S-25)	<input type="checkbox"/>	21.9	114.9	2516
22	A	Starter Relay Piper Dwg. 99130-2 RBM Controls P/N 111-111	<input checked="" type="checkbox"/>	1.0	45.8	46
23	A	Overvoltage Relay Piper Dwg. 35544 (Wico X16799)	<input checked="" type="checkbox"/>	0.5	55.4	28
24	A	Stall Warning Device Piper Dwg. 35544 (Safe Flight P/N C52207-4)	<input checked="" type="checkbox"/>	0.2	80.2	16

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(e) Instruments

Item No.		Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
25	B	Altimeter Piper PS50008-2 or -3 Cert. Basis - TSO C10b	_____	1.1	60.9	67
26	B	Airspeed Indicator Piper PS50049-41S Cert. Basis - TSO C2b	_____	0.6	61.8	37
27	A	Compass Piper Dwg. 67462 Cert. Basis - TSO C7c	_____ X	0.9	59.9	54
28	A	Tachometer Piper Dwg. 62177-3	_____ X	0.7	61.2	43
29	A	Engine Cluster Piper Dwg. 95241-17	_____ X	0.8	62.4	50

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