

SECTION 6 - WEIGHT AND BALANCE

PA-30 * 3600 LBS GROSS WEIGHT

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WEIGHT AND BALANCE

PA-30 * 3600 LBS GROSS WEIGHT

INTRODUCTION

This section describes the procedure for calculating the loaded weight and center of gravity of the Twin Comanche for various flight operations. In addition, procedures are provided for re-calculating the basic empty weight and center of gravity when removal and/or addition of equipment results in changes to these values.

In order to achieve the performance and flying characteristics which are designed into the aircraft, it must be flown with the weight and center of gravity position within the approved operating 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 this flexibility comes responsibility. The pilot must insure that the airplane is within the loading envelope before takeoff.

Misloading carries consequences for any aircraft. An overloaded airplane will not perform as well, or as safely, as a properly loaded one. The heavier the airplane is loaded within the approved limit, the less climb performance it will have, and the higher the stall speed will be.

Center of gravity is also a determining factor in any airplane's flight characteristics. If the C.G. is too far forward, it may be difficult to rotate for takeoff or flare for landing. Loading the airplane so that the center of gravity is toward, but within, the aft C.G. limit will result in less drag, a faster airplane and increased range. However, 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, which can lead to inadvertent stalls and even spins. Spin recovery becomes more difficult, and even impossible, as the center of gravity moves aft of the approved C.G. limit.

A properly loaded aircraft, by comparison, will perform as intended by its design. Before the airplane is delivered, it is weighed, and a basic empty weight and C.G. location are computed. Using this information, the pilot can easily determine the gross weight and C.G. location for the loaded airplane. This is accomplished by computing the total weight and moment following the example supplied in this section, and then determining whether they are within the approved envelope.

The basic empty weight and center of gravity location are recorded in the actual weight and balance record supplied with the airplane when new. Whenever equipment is installed and/or removed, or major modifications are made to the aircraft, the mechanic responsible for the work is required to compute the new basic empty weight and C.G. location, and record these in the aircraft logbook. The owner of the aircraft should make sure that this is done.

AIRPLANE WEIGHING PROCEDURE

At the time of licensing, Piper Aircraft Corporation provided each airplane with the basic empty weight and C.G. location. The removal and/or addition of equipment or aircraft modifications can affect the basic empty weight and center of gravity. The following procedure is used to re-determine the basic empty weight and C.G. location.

1.) Preparation:

- A.) Be certain that all items checked in the equipment list are installed in the proper location in the airplane.
- B.) Remove excessive dirt, grease, moisture and foreign items such as rags and tools from the airplane before weighing.
- C.) De-fuel the airplane, then add the unusable fuel (6.0 gallons total, 3.0 gallons to each main tank). Fill engines with oil.
- D.) Place pilot and copilot seats in a normal seating position (approximately the eighth notch aft of full forward position). Put flaps in the fully retracted position and all control surfaces in the neutral position. Secure the tow bar in its proper location and close all doors.

2.) Leveling:

- A.) With the airplane on scales, inflate main gear oleo pistons to the fully extended position.
- B.) Level the airplane both laterally and longitudinally by deflating the tires to center the bubble on the level. On serial numbers 30-1 through 30-901 the longitudinal level point is across the two machine screws above the baggage compartment door, and the lateral level point is located at the station 136.5 bulkhead in the baggage compartment. On serial numbers 30-902 and up the longitudinal level point is across the two machine screws on either side of the right rear window, and the lateral level point is the hat section channel of the forward cabin bulkhead.

3.) Weighing - Airplane Basic Empty Weight:

- A.) Weigh the airplane inside a closed building to prevent errors in scale readings due to wind.
- B.) With the airplane level and the brakes released, record the weight shown on each scale. Deduct the tare, if any, from each reading to determine the net weight. Basic empty weight is the sum of all three readings.

4.) Calculation - Basic Empty Weight Center of Gravity:

- A.) The basic empty weight center of gravity can be determined by the following formula:
(See Figure 6-01)

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

Where T=N+R+L

A=21.7 B=108.7

Maximum Useful Load - With Internal Reserve Fuel (30 US gal)	_____ lb
Gross Weight (With Tip Tanks Installed)	3,725 lb
Maximum Useful Load - With Tip Tank Reserve Fuel (30 US gal)	_____ lb

CENTER OF GRAVITY DATA

Basic Empty Measurement:

Center of Gravity (Aft of Datum) _____ in
Moment _____ in lb
Moment Increase With Landing Gear Retracted 770.0 in lb

Normal Category.

Weight Pounds	Arm Forward Limit Inches Aft of Datum	Arm Rearward Limit Inches Aft of Datum
3,725 *	87.6	91.4
3,600	86.5	92.0
3,200	83.0	92.0
2,450 or Less	81.0	92.0

**** NOTE ****

* Any weight in excess of 3,600 pounds must consist of symmetrically loaded fuel in the tip tanks.

Straight line variation exists between the points given.

When using auxiliary fuel, use wing tip tank fuel first.

Datum is located 79 inches ahead of the wing leading edge. It is measured longitudinally from station 65.5 and laterally from spanwise station 97.0 (First leading skin lap outboard of engine nacelle).

STATIONS

(Arm Aft of Datum)

Engine Oil	51.0 in
Front Seat Passengers	84.8 in
Basic Fuel - Inboard Tanks	90.0 in
Reserve Fuel - Outboard Tanks	95.0 in
Reserve Fuel - Tip Tanks (If Installed).....	90.5 in
Center Seat Passengers (SN 30-1 Through 30-589).....	118.5 in
Center Seat Passengers (SN 30-590 Through 30-2000)	120.5 in
Baggage Compartment	142.0 in
5th and 6th Seat Passengers (If Installed).....	148.0 in

WEIGHT AND BALANCE DETERMINATION FOR FLIGHT

1.) Use of the Weight and Balance Plotter:

A weight and balance plotter is available for the Twin Comanche, and greatly simplifies loading of the aircraft. The plotter was originally produced by Piper, and supplied with each airplane. When factory stock of the plotter was depleted, a reproduction was made available through the International Comanche Society. This second source is also exhausted, so no new plotter is available as of the publication date of this Manual.

The beginning reference point of the weight and balance plotter is the basic empty weight and C.G. of the airplane. This information can be obtained from the airplane logbook, and should be recorded in the "Weight and Balance Data Form" section of this chapter.

The term "basic empty weight" as it is used in this Manual includes unusable fuel and full engine oil. Original weight and balance data supplied with the PA-30 was "empty weight", and the additional weight and moment of unusable fuel and engine oil must be added to obtain the beginning reference point on the plotter.

Directions for use are on the face of the plotter. If a plotter is not available, the weight and balance can be determined manually by using the information contained herein.

2.) Manual Method of Determining Weight and Balance:

- A.) Add the weight of all items to be loaded to the airplane's basic empty weight.
- B.) Multiply the weight of each item by the stations arm to determine the moment of all items.
- 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 with landing gear extended.
- E.) Add the moment increase with landing gear retracted.
- F.) Divide the new total moment by the total weight to determine the C.G. location with landing gear retracted.
- G.) Determine that total weight and C.G. meet weight and balance requirements.

LOADING PROBLEM EXAMPLE

Item	Weight (lbs)	Arm (Aft of Datum)	Moment (in lb)
Empty Weight as Weighted at Factory	2,386.0	83.6	199481.6
Engine Oil (16 US qts)	30.0	51.0	1530.0
Unusable Fuel (Inboard Tanks - 6 US gal)	36.0	90.0	3240.0
Basic Empty Weight	2,452.4	83.3	204251.6
Fuel (Inboard Tanks - 54 US gal)	324.0	90.0	29160.0
Fuel (Outboard Tanks - 30 US gal)	180.0	95.0	17100.0
Pilot and Passenger (Front Seats)	310.0	84.8	26288.0
Passengers (Center Seats)	185.0	120.5	22292.5
Passengers (5th and 6th Seats)	60.0	148.5	8880.0
Baggage	34.0	142.0	4828.0
Total	3,545.0	88.2	312800.1
Fuel (Tip Tanks - 30 US gal - If Installed)	180.0	90.5	16290.0
Total	3,725.0	88.3	329090.1
Moment Increase With Landing Gear Retracted			770.0
Total	3,725.0	88.6	329860.1

SAMPLE LOADING PROBLEM

Item	Weight (lbs)	Arm (Aft of Datum)	Moment (in lb)
Basic Empty Weight	_____	_____	_____
Fuel (Inboard Tanks - 54 US gal Usable)	_____	90.0	_____
Fuel (Outboard Tanks - 30 US gal Usable)	_____	95.0	_____
Pilot and Passenger (Front Seats)	_____	84.8	_____
Passengers (Center Seats - SN 30-1 to 30-589)	_____	118.5	_____
Passengers (Center Seats - SN 30-590 and Up)	_____	120.5	_____
Passengers (5th and 6th Seats - 235 lb Max)	_____	148.0	_____
Baggage (200 or 250 lb Capacity)	_____	142.0	_____
Total (3600 lb Maximum Allowable)	_____	_____	_____
Fuel (Tip Tanks - 30 US gal - If Installed)	_____	90.5	_____
Total (3725 lb Maximum Allowable)	_____	_____	_____
Moment Increase With Landing Gear Retracted			770.0
Total	_____	_____	_____

**** NOTE ****

100/130 Octane Fuel Density is Calibrated at: 6.00 lbs/gal (0.72 kg/L)
 100 LL Fuel Density is Calibrated at: 5.82 lbs/gal (0.70 kg/L)
 Ashless Dispersant Oil Density is Calibrated at: 1.875 lbs/qt or 7.50 lbs/gal (0.90 kg/L)

EQUIPMENT LIST

	Mark if Installed	Weight (lbs)	Arm (Aft of Datum)	Moment (in lb)
1.) Engines:				
One or Two Lycoming Model IO-320-B	_____	293.0 ea.	45.8	26838.8
One Lycoming Model LIO-320-B (Right)	_____	293.0	45.8	13419.4
2.) Propellers and Accessories:				
Two Hartzell Constant Speed, Full Feathering Model HC-E2YL-2, 2A, 2B, 2C or 2D With HC-7663-4 Blades or One Model HC-E2YL-2BL With J7663-4 Blades (Right)	_____	54.5 ea.	23.0	2507.0
Two Governors - Hartzell Model F-6, F-6-3 F-6-3A, or F-6-3S (Left) or F-6-3AL (Right)	_____	4.6 ea.	61.8	568.6
Two Spinner Domes and Bulkhead Adapters	_____	4.0 ea.	20.1	160.8
3.) Engine Accessories:				
Two Fuel Pumps - Aux. Electric, Rotary One Weldon No. 8100A (R) and One Weldon No. 8100AA (L) or One Weldon No. 8100C (R) and One Weldon No. 8100CC (L) or One Weldon No. B8100C (R) and One Weldon No. B8100CC (L)	_____	3.0 ea.	90.0	540.0
Two Fuel Pumps - Engine Driven AC JT Model No. 5656696-A AC JT Model No. 6440160 AC JT Model No. 6440296 AC JT Model No. 6440652 AC JT Model No. GP5656999	_____	3.0 ea.	90.0	540.0
Two Fuel Pumps - Engine Driven AC JT Model No. 5656696-A AC JT Model No. 6440160 AC JT Model No. 6440296 AC JT Model No. 6440652 AC JT Model No. GP5656999	_____	2.0 ea.	58.0	232.0
Two Oil Radiators Harrison Model No. APO7AU06-03	_____	2.0 ea.	58.0	232.0
Two Oil Radiators Harrison Model No. APO7AU06-03	_____	2.0 ea.	58.0	232.0
Two Oil Radiators Harrison Model No. APO7AU06-03	_____	2.0 ea.	58.0	232.0
Two Oil Radiators Harrison Model No. APO7AU06-03	_____	2.0 ea.	58.0	232.0
Two Oil Radiators Harrison Model No. APO7AU06-03	_____	2.0 ea.	58.0	232.0
Two Oil Radiators Harrison Model No. APO7AU06-03	_____	2.1 ea.	62.3	130.8
Two Starters				
Delco Remy 12 Volt, Model No. 1109511 or Model No. 11-1923 (Right)	_____	18.0 ea.	37.0	1332.0
Prestolite 12 Volt, Model No. MZ-4206	_____	18.0 ea.	37.0	1332.0
Two Vacuum Pumps				
Airborne Mechanisms Model No. 113A8, or 200CC (L) or 200CW (R)	_____	3.5 ea.	58.9	412.3
Two Full Flow Oil Filters W/Adapters				
AC No. 5578941 or Lycoming 75528	_____	2.5 ea.	60.6	303.0
AC No. 5578770 or Lycoming 74911	_____	2.5 ea.	60.6	303.0
AC No. 5578770 or Lycoming 77853	_____	2.5 ea.	60.6	303.0
Two Induction Air Filters				
Fram Model No. CA-144-PL	_____	0.7 ea.	57.0	79.8
Two 15 Gal Brittain Tip Tanks STC SA727WE	_____	25.0	91.2	2280.0

EQUIPMENT LIST (Cont.)

	Mark If Installed	Weight (lbs)	Arm (Aft of Datum)	Moment (in lb)
4.) Landing Gear:				
Two Main Wheel Brake Assemblies				
6:00 X 6 Type III				
Wheel, Cleveland 40-34				
Brake, Cleveland 30-23	_____	10.6 ea.	108.5	2300.2
6:00 X 6 Type III				
Wheel, Cleveland 40-90				
Brake, Cleveland 30-23	_____	10.6 ea.	108.5	2300.2
Two Main Wheel Tires (W/Tubes)	_____	9.4 ea.	108.5	2039.8
One Nose Wheel 6:00 X 6 Type III				
Wheel, Cleveland 38501 (Less Drum)	_____	6.4	21.0	134.4
One Nose Wheel Tire (W/Tube)	_____	9.4	21.0	197.4
5.) Electrical Equipment:				
Generator				
Delco Remy 12 Volt - 50 Ampere	_____	18.0	37.0	666.0
Dual Generators				
Delco Remy 12 Volt - 50 Ampere	_____	38.7	38.2	1478.3
Dual Alternators				
Prestolite 12 Volt - 70 Ampere	_____	32.0	38.1	1219.2
Battery - Forward Mount				
12 Volt - 35 Ampere Hour	_____	27.0	16.8	453.6
Battery - Aft Mount				
12 Volt - 35 Ampere Hour	_____	27.0	162.0	4374.0
Two Landing Lights				
GE Model 4509	_____	1.0 ea.	86.0	172.0
Rotating Beacon				
Whelen No. WRML-12	_____	1.4	275.0	385.0
Anti-Collision Lights				
Whelen Red Strobe Model HS	_____	3.1	175.2	543.1
Whelen White Strobe Model HD-T2	_____	4.8	134.4	645.1
Heaters				
Janitrol Model No. 20D35	_____	29.0	15.0	435.0
Southwind Model No. 94C-DC12	_____	24.5	15.0	367.5
6.) Autopilots:				
Piper Auto Control II (W/O Gyros)	_____	4.6	55.3	254.4
Piper Auto Control III (W/O Gyros)	_____	4.0	113.0	452.0
Piper Altimatic II (W/O Gyros)	_____	13.1	56.5	740.2
Piper Altimatic II (W/O Gyros)	_____	17.1	81.4	1391.9
Piper Altimatic III (W/O Gyros)	_____	18.9	119.5	2258.6

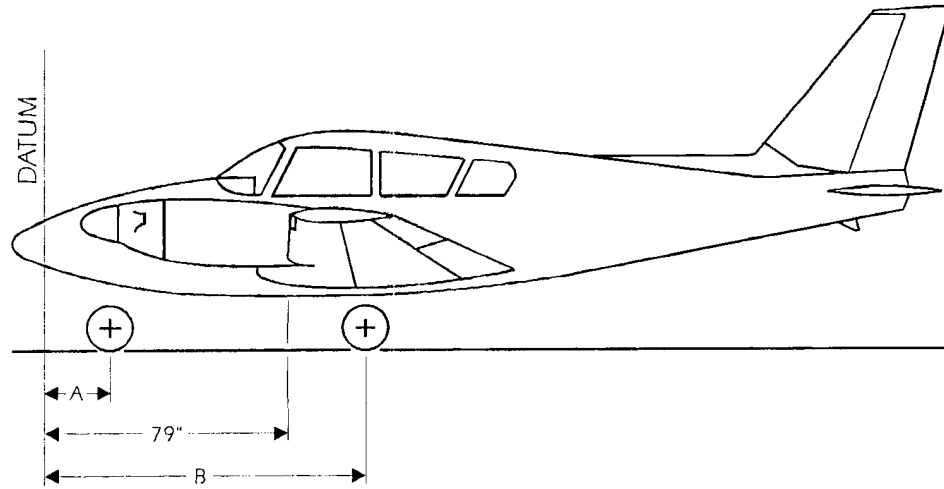
EQUIPMENT LIST (Cont.)

	Mark If Installed	Weight (lbs)	Arm (Aft of Datum)	Moment (in lb)
7.) Miscellaneous Equipment:				
Heated Pitot Head PAC 21301	_____	1.0	99.0	99.0
Fire Extinguisher - Walter Kidde PAC 21731	_____	5.0	84.8	424.0
Fire Extinguisher - MIL-E-5220A PAC 21731	_____	8.0	84.8	678.4
Fire Extinguisher - Scott Aviation PAC 21731	_____	4.3	84.8	364.6
Mixture Monitor PAC 25280	_____	2.0	68.0	136.0
Mixture Monitor PAC 26738	_____	2.5	61.6	154.0
Mixture Control Indicator PAC 26738	_____	2.5	61.6	154.0
Dual Brake Installation (Copilot) PAC 24438	_____	5.0	58.0	290.0
Dual Tachometer Installation PAC 26897	_____	2.2	64.6	142.1
Dual Altimeter Installation PAC 26730	_____	3.0	64.2	192.6
Piper Radio Coupler PAC 25001	_____	0.5	66.0	33.0
Piper Electric Trim PAC 24889	_____	4.0	163.0	652.0
Anti-Static Equipment PAC 25043	_____	2.0	154.0	308.0
Air Flow Modification Kit PAC 27205	_____	1.6	110.0	176.0
Rudder-Aileron Connect Kit PAC SK2169	_____	2.3	123.0	282.9
Seat Installation - Fifth PAC 25302	_____	7.5	148.0	1110.0
Seat Installation - Sixth PAC 26602	_____	7.5	148.0	1110.0
Vertically Adjustable Front Seats PAC 26971	_____	21.3 ea.	84.8	3612.5
Head Rests (Seats 1 & 2) PAC 26652	_____	1.0 ea.	95.0	190.0
Head Rests (Seats 3 & 4) PAC 26652	_____	1.0 ea.	130.0	260.0
Shoulder Harness (Seats 1 & 2) PAC 27006	_____	0.6 ea.	100.0	120.0
Shoulder Harness (Seats 3 & 4) PAC 27006	_____	0.6 ea.	133.0	159.6
Aux Power Receptacle W/Jumper Cable	_____	7.0	153.3	1073.1
Aux Power Receptacle W/Jumper Cable	_____	6.5	113.3	736.5
Oxygen System Installation PAC 25342	_____	41.5	161.2	6689.8
Oxygen System Installation PAC 25542	_____	41.5	161.2	6689.8
Oxygen System Installation PAC 25724	_____	41.5	161.2	6689.8
Oxygen System Installation PAC 26682	_____	41.5	161.2	6689.8
Glar Ban Lights PAC 26871	_____			Negligible Weight Change
Stall Warning Indicator PAC 26651	_____			Negligible Weight Change
Landing Gear Security Kit PAC 760-627	_____			Negligible Weight Change
Alternate Static Air Source PAC 26722	_____			Negligible Weight Change
DMCR Approved Airplane Flight Manual	_____			Negligible Weight Change
FAA Approved Airplane Flight Manual	_____			Negligible Weight Change
Applicable Flight Manual Supplements	_____			Negligible Weight Change

WEIGHT AND BALANCE

PA-30 * 3600/3725 POUNDS GROSS WEIGHT

SERIAL NO: 30 - _____ REGISTRATION NO: N - _____ DATE: _____



Basic Empty Weight as Weighed

Left Wheel	(L)	_____
Right Wheel	(R)	_____
Nose Wheel	(N)	_____
Total	(T)	_____

APPROVED C.G. RANGE AND WEIGHT

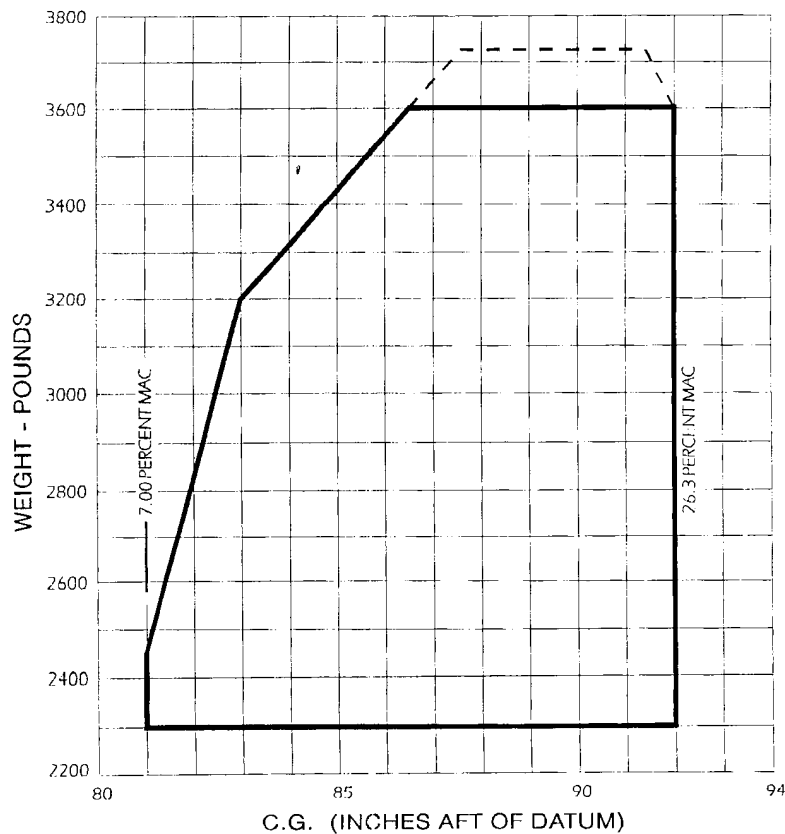


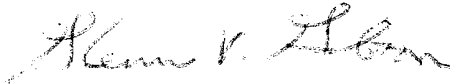
FIGURE 6-01

AIRCRAFT WEIGHT AND BALANCE
PA-30
S/N 30-1351
N125RJ

LEFT MAIN	1109	108.5	120327
RIGHT MAIN	1110	108.5	120435
NOSE WHEEL	810	21.0	17010
SUBTRACT FUEL	-324	90.0	-29160
SUBTRACT FUEL	-180	95.0	-17100
TOTAL	2525	83.8	211512

THIS AIRCRAFT WEIGHED ON CALIBRATED SCALES
IN THE LEVEL POSITION FULL OF OIL AND FUEL

06/23/08
A & P 2787173



Aircraft Weight and Balance Revision

Tail Number: N125RJ			Date: 4/10/07		
Prepared by: AIRCRAFT ENGINEERING INC PO BOX 1319 EAGLE LAKE, FL 33839			Work Order No:		
			Type Certificate Data No:		
Aircraft Make: PIPER	Model: PA-30	Serial No: 30-1351	Time:		
Registered Owner: MICAIR AIRCRAFT LLC		Address: 431 RIDGE CT LAKE IN THE HILLS IL 60156-4419			
Maximum Weight 3600		CG Range FWD		AFT	
As Received; Date of Previous Weight and Balance: 3/1/05		Useful Load: 1080.58	EW: 2519.92	EWCG: 83.18	Moment: 209608.45
Notes: SUPPLEMENTAL EQUIPMENT LIST					
			Weight	Arm	Moment
INSTALLED KNOTS 2U WING FILLET			1	140	140.00
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
<input checked="" type="checkbox"/> As Calculated <input type="checkbox"/> As Weighed		Moment 209748.45 <hr/> Weight 2520.92	New Empty Weight CG 83.20		New Useful Load 1079.58
Signature BILL TURLEY, INSPECTOR					
Repair Agency or License No: VF4R594M					