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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 a tremendous flexibility of loading, you cannot fill the airplane 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 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 the C.G. 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 that 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.

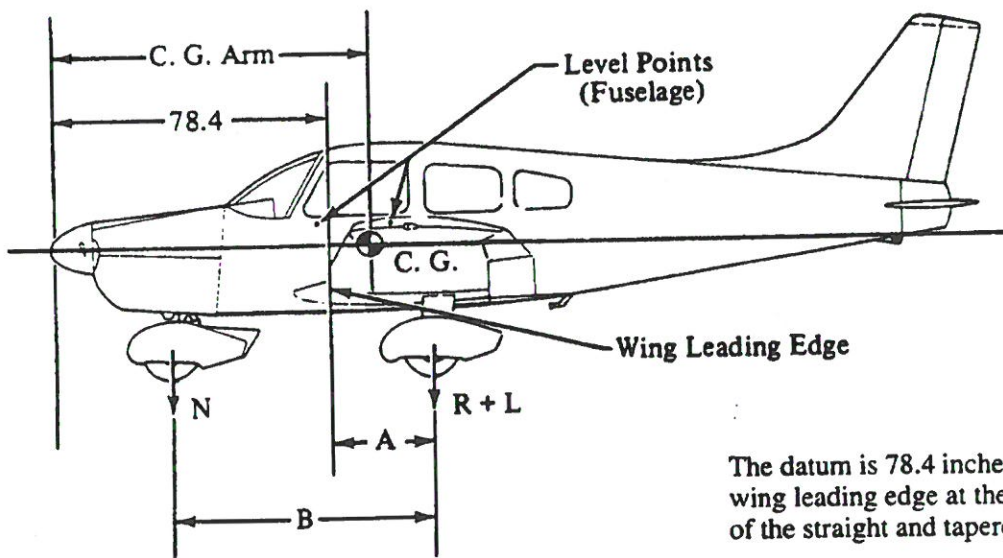
Scale Position and Symbol	Scale Reading	Tare	Net Weight
Nose Wheel (N)			
Right Main Wheel (R)			
Left Main Wheel (L)			
Basic Empty Weight, as Weighed (T)	—	—	

**WEIGHING FORM**

Figure 6-1

(d) Basic Empty Weight Center of Gravity

- (1) The following geometry applies to the PA-28-181 airplane when it is level. Refer to Leveling paragraph 6.3 (b).



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

A =

B =

**LEVELING DIAGRAM**

Figure 6-3

- (2) Obtain measurement "A" by measuring from a plumb bob dropped from the wing leading edge, at the intersection of the straight and tapered section, horizontally and parallel to the airplane centerline, to the main wheel centerline.
- (3) Obtain measurement "B" by measuring the distance from the main wheel centerline, horizontally and parallel to the airplane centerline, to each side of the nose wheel axle. Then average the measurements.
- (4) The basic empty weight center of gravity (as weighed including optional equipment, full oil and unusable fuel) can be determined by the following formula:

$$\text{C.G. Arm} = 78.4 + A - \frac{B(N)}{T}$$

C.G. Arm = 78.4 + (            ) -  $\frac{(\quad)(\quad)}{(\quad)}$  =            inches

**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-28-181 CHEROKEE ARCHER II

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

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

Date \_\_\_\_\_

AIRPLANE BASIC EMPTY WEIGHT

Item	Weight (Lbs)	x	C. G. Arm (Inches Aft of Datum)	=	Moment (In-Lbs)
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

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

Normal Category (2550 lbs) - (        lbs) =        lbs.

Utility Category (1950 lbs) - (        lbs) =        lbs.

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.

WEIGHT AND BALANCE DATA FORM

Figure 6-5

ISSUED: AUGUST 15, 1975

REPORT: VB-760  
6-7

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**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.

	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 (48 Gallon Maximum)		95.0	
Baggage*		142.8	
Total Loaded Airplane			

The center of gravity (C.G.) 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.

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

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

**SAMPLE LOADING PROBLEM (NORMAL CATEGORY)**

Figure 6-9

**SECTION 6  
WEIGHT AND BALANCE**

**PIPER AIRCRAFT CORPORATION  
PA-28-181, CHEROKEE ARCHER II**

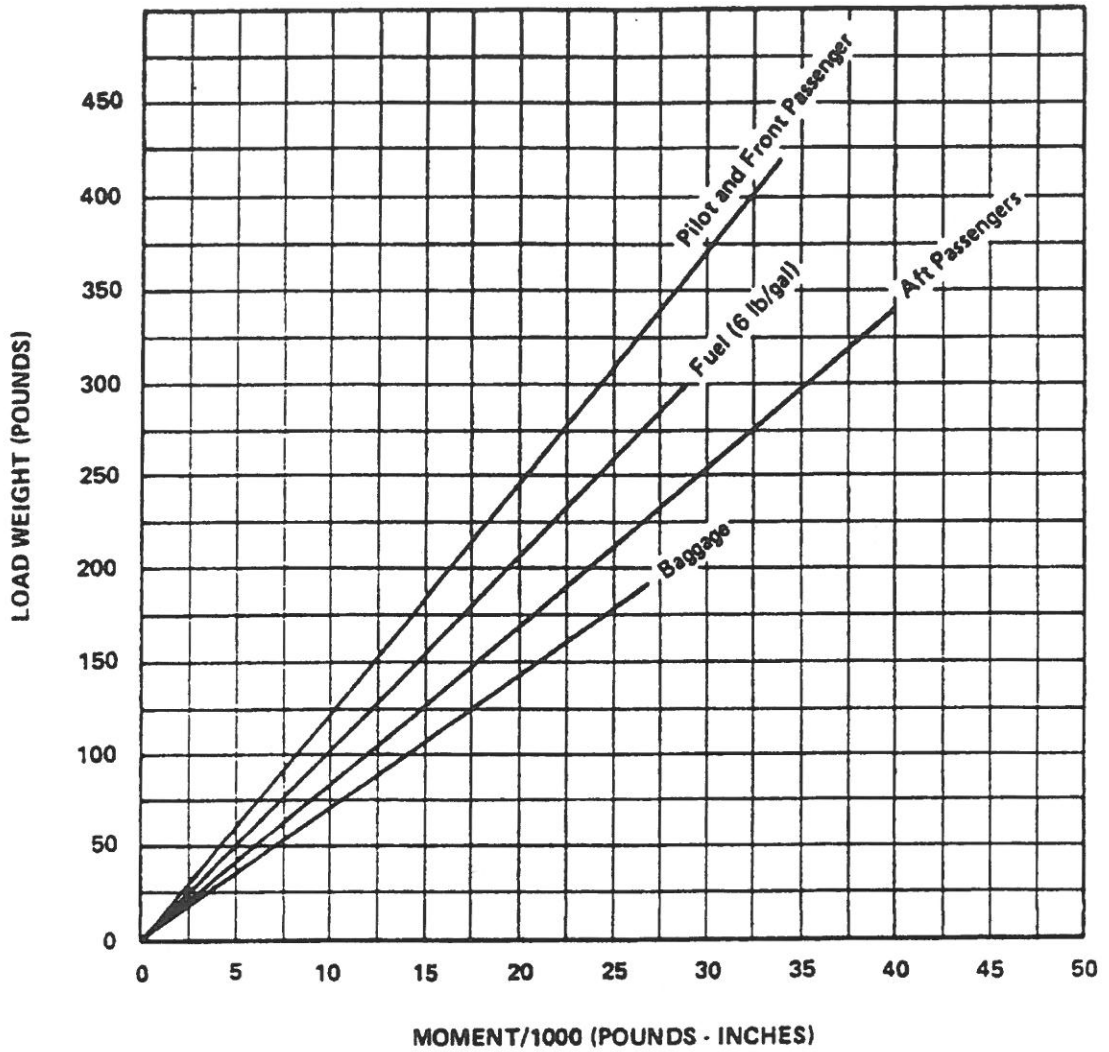
	<b>Weight (Lbs)</b>	<b>Arm Aft Datum (Inches)</b>	<b>Moment (In-Lbs)</b>
Basic Empty Weight			
Pilot and Front Passenger		80.5	
Passengers (Rear Seats)*		118.1	
Fuel (48 Gallon Maximum)		95.0	
Baggage*		142.8	
Total Loaded Airplane			

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 6-00). If the airplane has been altered, refer to the Weight and Balance Record for this information.

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

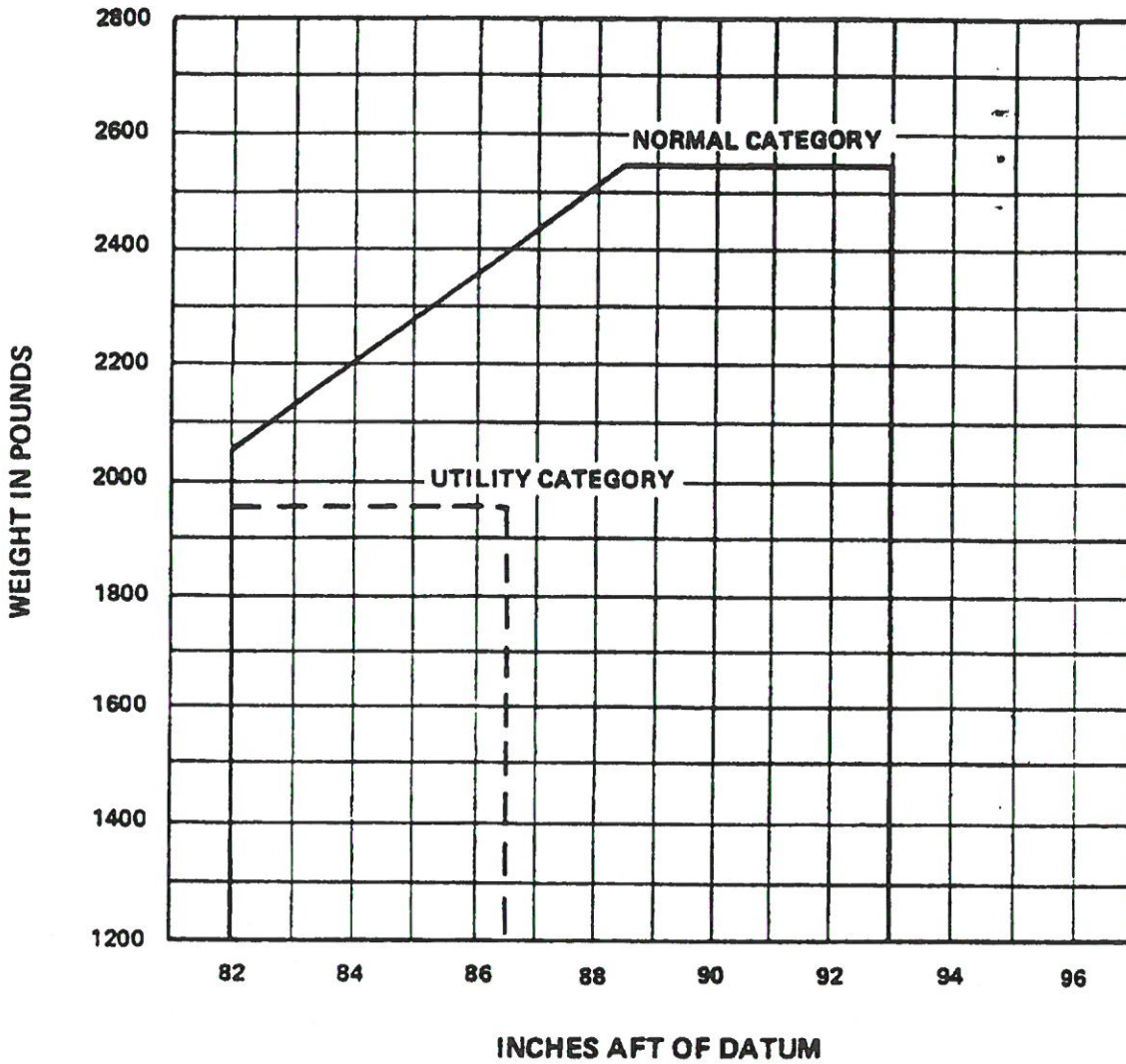
**WEIGHT AND BALANCE LOADING FORM**

Figure 6-11



LOADING GRAPH

Figure 6-13



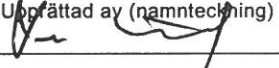
C.G. RANGE AND WEIGHT

Figure 6-15



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Luftfartyg typ Piper PA 28-181	Tillverkningsnummer 28-7690149
Plats och datum vid upprättande Bromma 04-02-27	Upprättad av (namnteckning) 
Upprättare (namnförtydligande) Per Sjöstedt	Behörighet (JAR 145, RSC, MM cert) Bes.man MM-5108061671

INSTALLERAD UTRUSTNING ingående i grundtomvikten vid vägning

Ant	Benämning	Fabrikat/typ	Ant	Benämning	Fabrikat/typ
	<b>Motor och propeller med utrustning</b>			<b>Landställ</b>	
1	Motor	Lyc. 0-360-A4M	2	Huvudhjul med broms	
1	Motor		1	Nosbromshjul	
1	Startmotor		-	Hjulkåpa	
1	Alternator		-	Medar	
-	Hydraulpump				
1	Vakuumpump			<b>Elutrustning</b>	
1	Bränslepump (motordriven)		1	Batteri 12./35... V/Ah	
1	Bränslepump (eldriven)		1	Markbatteriuttag	
			1	Landningsstrålkastare	
			-	Taxistrålkastare	
			set	Mavigationsljus	
			set	Kollisionsvarningsljus	
			1	Motorvärmare	EZ-heat
1	Propeller	Sen 76EM8S5-0-60			
1	propeller				
-	propellerspinner				
-	Propellerregulator				

L 1503a-4

Upprättas i 2 ex varav 1 ex sänds till Luftfartsinspektionens distriktskontor.  
\* Utrustning som fordras supplement till flyghandbok.

Behörighet (JAR 145, RSC, MM cert) Bes.man  
MM-5108061671

Klipp här

INSTALLERAD UTRUSTNING ingående i grundtomvikten vid vägning

Ant	Benämning	Fabrikat/typ	Ant	Benämning	Fabrikat/typ
	<b>Instrument utrustning</b>			<b>Diverse utrustning</b>	
1	Fartmätare		1	Hållare för IAL-kort belyst	Autocontrol IIIB
2	Höjdmätare		1	Stallvarning	
1	<del>Höjdmätare med kodgivare</del>		-	Venturirör	
1	Magnetkompass		1	Pitotrör, eluppvärmt	
1	Variometer		1	Autopilot	
1	Svängindikator		-	Eltrim	
1	Horisontgyro		-	Kabinvärmare	
1	Kursgyro		-	Oxygenanläggning	
-	Slavgyrosystem		-	Deicer - ving & stjärtparti	
1	Ytterlufftermometer		-	Deicer - prop.	
1	Flygplanur		-	Deicer - frontruta	
1	Tersur		-	Fronttutetorkare	
1	Indikator, instrument-vakuumpump/tryck		1	Markventilationsanläggning	
1	Indikator varvtal (RPM-indikator)		4	Midjebälte	
-	Indikator, ingasträck		2	Axelremmar/3-punktsbälte	
-	Indikator, bränsleflöde		-	Barnsäte/extrasäte	
1	Indikator, bränsletryck		-	Bogserkoppl. m/u backspegel	
-	Indikator, cylindertemp.		1	Handbrandsläckare	
-	Indikator, luftintagstemp.		1	Motorbrandsläckare	
1	Indikator, avgastemp		1	Förbandslåda	
1	Amp.medtermostat och lampa	-	Flytvästar		
-	Voltmeter	2	Handlampa		
1	Varn.lampa, låg spänning	1	Flyghandbok		

L 1503b-4

Upprättas i 2 ex varav 1 ex sänds till Luftfartsinspektionens distriktskontor.  
\* Utrustning som fordras supplement till flyghandbok.

Behörighet (JAR 145, RSC, MM cert) Bes.man  
MM-5108061671



INSTALLERAD UTRUSTNING ingående i grundtomvikten vid vägning

Ant	Benämning	Fabrikat/typ	Ant	Benämning
	<b>Radio/Nav utrustning</b>			<b>Antenner</b>
1	VHF/kom	Garmin GNS-430	2	VHF/kom
1	VHF/kom	King KX-175B	-	HF/kom
-	HF/Kom		1	VHF/nav
1	VOR + ILS/LLZ	Garmin GI-106	1	ILS/GP
1	VOR + ILS/LLZ	King KI-214	1	ILS/M
1	ILS/GP	Ingår i GI-106	1	ADF, hjälp
1	ILS/GP	Ingår i KI-214	1	ADF, loop
1	MKR	King KMA-20	1	SSR-transponder
-	MKR		1	DME
-	R - NAV		-	Radiohöjdmätare
-	V - NAV		1	ELT utvändig
-	GNS		-	GNS
1	GPS	Garmin GNS-430	1	GPS
1	ADF	King KR-85		
-	ADF			
1	SSR- (ATC)Transponder	King KT-76		
1	DME	King KN-62		
-	Radiohöjdmätare			
-	Radar			
1	ELT	Narco ELT-10		
1	Intercom	PM 1000-II		
1	Installationssats R-72			
-	Hörtelefon/Headset			
1	Kabinhögtalare			
1	Handmikrofon			

L 1503c-4

Upprättas i 2 ex varav 1 ex sänds till Luftfartsinspektionens distriktkontor.  
\* Utrustning som fordras supplement till flyghandbok.

Behörighet (JAR 145, RSC, MM cert) Bes.man  
MM-5108061671

Clipp här

Bränsle/oljemängd (utnyttjbar)				ALTERNATIV UTRUSTNING ej ingående i grundtomvikten vid vägning. Se speciell grundtomviktsbestämning enl. blankett L 1502					
Tankar	Antal	Liter/tank	Momentarm cm	Ant	Benämning	Fabrikat/typ	Vikt kg/st	Momentarm cm	
Vinge (standard/inner)	2	91	241	-	Huvudskidställ				
Vinge (långfärd)				-	Nos-/sporrskidställ				
Vinge (ytter)									
Vinge (tip)									
Vinge (nacell)									
Kropp									
Olja (ingår i grundtomv.)									
Fasta bagage- och lastutrymmen									
Benämning		Max kg	Momentarm cm						
Främre		91	363						
Bakre									
Nacell									
Förar- och passagerarplatser samt lastsektioner i kabinen									
	Be-teckn.	Antal eller max kg	Momentarm cm						
Förare		1	204						
Förare (alt passagerare)		1	204						
Passagerare		2	300						
Passagerare									
Barn									
				0,5% av max landningsvikt		0,5% av medelkorda			
				5,8 kg		0,7 cm			

L 1503d-4

Upprättas i 2 ex varav 1 ex sänds till Luftfartsinspektionens distriktkontor.  
\* Utrustning som fordras supplement till flyghandbok.

Behörighet (JAR 145, RSC, MM cert) Bes.man  
MM-5108061671

