

CHAPTER 6

MASS (WEIGHT) AND BALANCE / EQUIPMENT LIST

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6.1. INTRODUCTION

To obtain the flight performance, flight characteristics and safe flight operation described in this Flight Manual, the airplane must be operated well within the permissible load and balancing envelope presented in this manual. It is the pilot's responsibility to adhere the load and balance limitations as well as to account for the change of the CG position due to the consumption of fuel during flight. The permissible balance envelope during flight is described in Chapter 2. The procedures for weighing the airplane as well as the method of calculating the CG position are given in this Chapter.

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Prior to delivery of an airplane, the empty mass (weight) and the CG position are determined. Empty mass (weight) and the center of gravity are recorded in a Weighing Report as illustrated in Figure 6.1 and in the Mass (Weight) & Balance Report (Figure 6.2).

NOTE

After equipment changes the new empty mass (weight) and the corresponding CG must be determined by calculation or weighing.

After repair or painting work the new empty mass (weight) and the corresponding CG must be determined by weighing.

Empty mass (weight) and corresponding CG position and moment must be entered in the Mass (Weight) & Balance Report by an authorized person.

The following pages are sample forms which can be used for airplane weighing, calculation of the CG position, and for the determination of the useful load.

6.2. AIRPLANE WEIGHING

Pre-weighing Conditions:

- Equipment must be in accordance with the airplane equipment list.
- Inclusive brake fluid, lubricant (3 liters / 3.17 US qts.), coolant (2,5 liters / 2.64 US qts.) and unusable fuel (2 liters / 0.53 US gal.).

To determine the empty mass (weight) and the CG position, the airplane is to be positioned in the above mentioned pre-weighing condition, with the nose gear and the main gears on a scale each. It should be ensured that the longitudinal axis of the airplane is in a horizontal position as illustrated on the Weighing Report (see Figure 6.1).

With the airplane correctly positioned, a plumb line is dropped on the leading edge of the wing from the root rib to the ground to determine the reference datum (RD). From this plane, the distances x_1 , x_{2li} (left), and x_{2re} (right) are measured to the wheel axes and recorded in the Weighing Report. The empty mass (weight) is calculated from the individual values of G_1 , G_{2li} (left), and G_{2re} (right).

The formula:

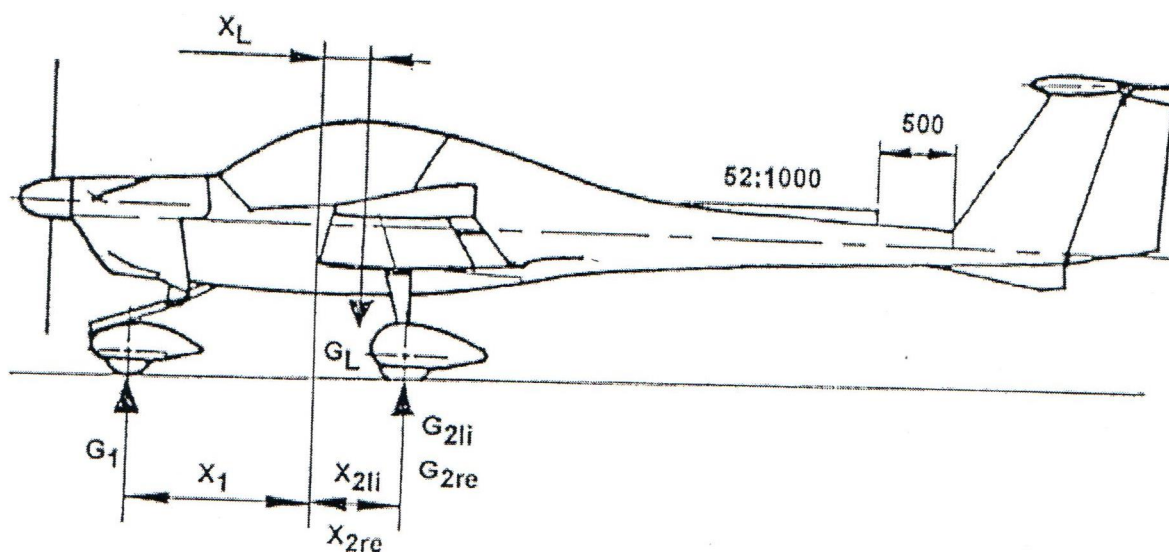
$$x_L = \frac{1}{G_L} * (G_{2li} * x_{2li} + G_{2re} * x_{2re} - G_1 * x_1)$$

yields the empty mass (weight) CG position aft of RD.

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The most important lever arms, indicated in meters (inches) aft of RD (leading edge of wing at the root rib):

- Pilot, Copilot: : 0.143 m (5.63 in)
- 79 liters (20.9 US gal.) Tank : 0.824 m (32.44 in)
- Baggage (max 20 kg (44 lbs)) : 0.824 m (32.44 in)



Weighing Schematic

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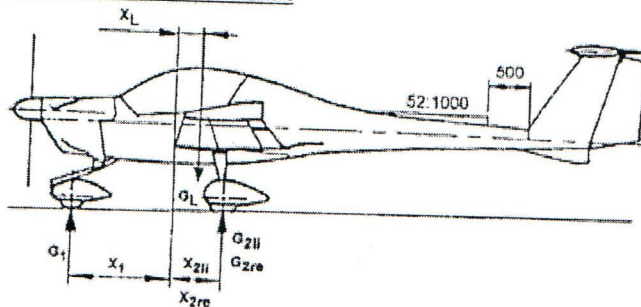
Figure 6.1: Weighing Report

Model: DV 20S/N.: 20.139Registration: PH-UISJ

Data in accordance with TCDS and Flight Manual

Reason for Weighing: acceptance checkReference Datum: Leading edge of wing at root ribHorizontal reference line: Wedge 52:1000, 500 mm (19.69 in.) forward of rudder fin

Weighing and empty mass (weight) CG

Equipment list - dated: 11 sept 1995Weighing Conditions: Including Brake Fluid,
Lubricant, Coolant and
Unusable Fuel (1.5 kg /3.31 lbs.)

Support	Gross [kg] ([lbs])	Tare [kg] ([lbs])	Net Mass [kg] ([lbs])	Lever Arm [m] ([in])
Front G ₁			79.1	x ₁ = 1.128
Rear G _{2L}			428.5	x _{2L} = 0.505
Rear G _{2R}				x _{2R} =
Empty Mass(Weight) G _L = 507.6 kg (lbs.)				

CG Position for Empty Mass (Weight): 0.318Empty Mass (Weight) Moment: $M_L = G_L \cdot x_L = \underline{\hspace{2cm}} \cdot \underline{\hspace{2cm}} = 161.41 \text{ kg} \cdot \text{m} \text{ (in} \cdot \text{lbs)}$

Maximum Permissible Useful Load:

Maximum Mass (Weight) [kg] ([lbs])	730
Empty Mass (Weight) [kg] ([lbs])	507.6
Max useful Load [kg] ([lbs])	222.4

Data to be entered into the Flight Manual: see page 6 - 6

Empty Mass (Weight) [kg] ([lbs.])	Empty Mass Moment [kg*m] ([in*lbs])
507.6 kg	161.41 kg/m

Place / Date LOAN 11.09.1995	A.M.E.'s Stamp checked 03-10-2011	A.M.E.'s Signature L.H.J. v. Hooijdonk LIC-AML NL-10140
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6.3. MASS (WEIGHT) AND BALANCE REPORT

The empty mass (weight) and empty mass (weight) CG position data determined prior to delivery of the airplane is the first entry in the Mass (Weight) and Balance Report. Each change of the installed equipment as well as each repair affecting the empty mass (weight) or empty mass (weight) CG position must be entered in the Mass (Weight) and Balance Report.

For calculations of the flight mass (weight) and the corresponding center of gravity, or the flight mass (weight) moment, the latest empty mass (weight) and the corresponding center of gravity or the empty mass (weight) moment must be used.

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Figure 6.2: Mass(Weight) and Balance Report

(Continuous report of structural changes or change of equipment).

[illegible]

6.4. FLIGHT MASS(WEIGHT) AND CENTER OF GRAVITY

The following data enables the pilot to operate the DV 20 within the required mass (weight) and center of gravity limitations.

The following diagrams:

Figure 6.3 Mass (Weight) & Balance Diagram

Figure 6.4 Permissible Center of Gravity Range
and permissible Flight Mass (Weight) Moment

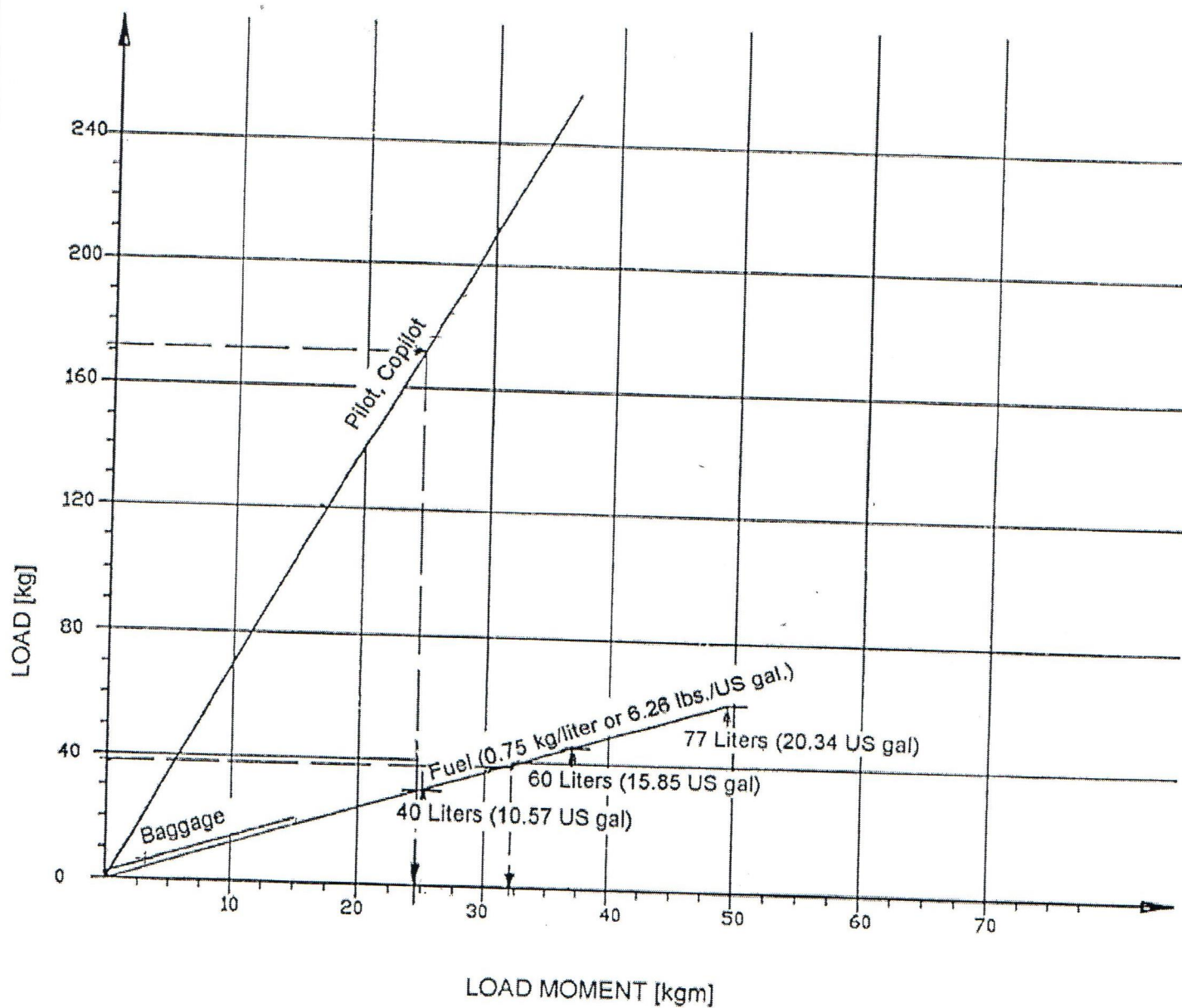
Figure 6.5 Calculation of Loading Condition

are to be used for calculations of the flight mass (weight) and the center of gravity as follows:

1. The empty mass (weight) and the empty mass (weight) moment of the airplane should be taken from the Mass (Weight) & Balance Report and entered into the form "Calculation of Loading Condition" (Figure 6.5) in the columns identified with "Your DV 20".
2. Using the Mass (Weight) & Balance Diagram (see Figure 6.3) determine the moment for each item to be loaded, and enter it in the respective column in Figure 6.5.
3. Add the masses (weights) and the moments of each column (items 4 and 6 in Figure 6.5) and enter the sum in Figure 6.4 "Permissible CG Range and Permissible Flight Mass (Weight) Moment" to check if the values are within the permissible limits of the loading range.

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Figure 6.3: Mass(Weight) & Balance Diagram



Example: Pilot and Passenger: 172 kg (380 lbs.)

Fuel (0.75 kg/liter): 38 kg

(6.26 lbs./US gal. : 84 lbs.)

Result: Moment of Pilot and Passenger: 24.6 kgm (2112 in.lbs.)

Moment of Fuel: 32 kgm (2747 in.lbs.)

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Figure 6.4: Permissible Center of Gravity Range and permissible Flight-Mass(Weight)-Moment

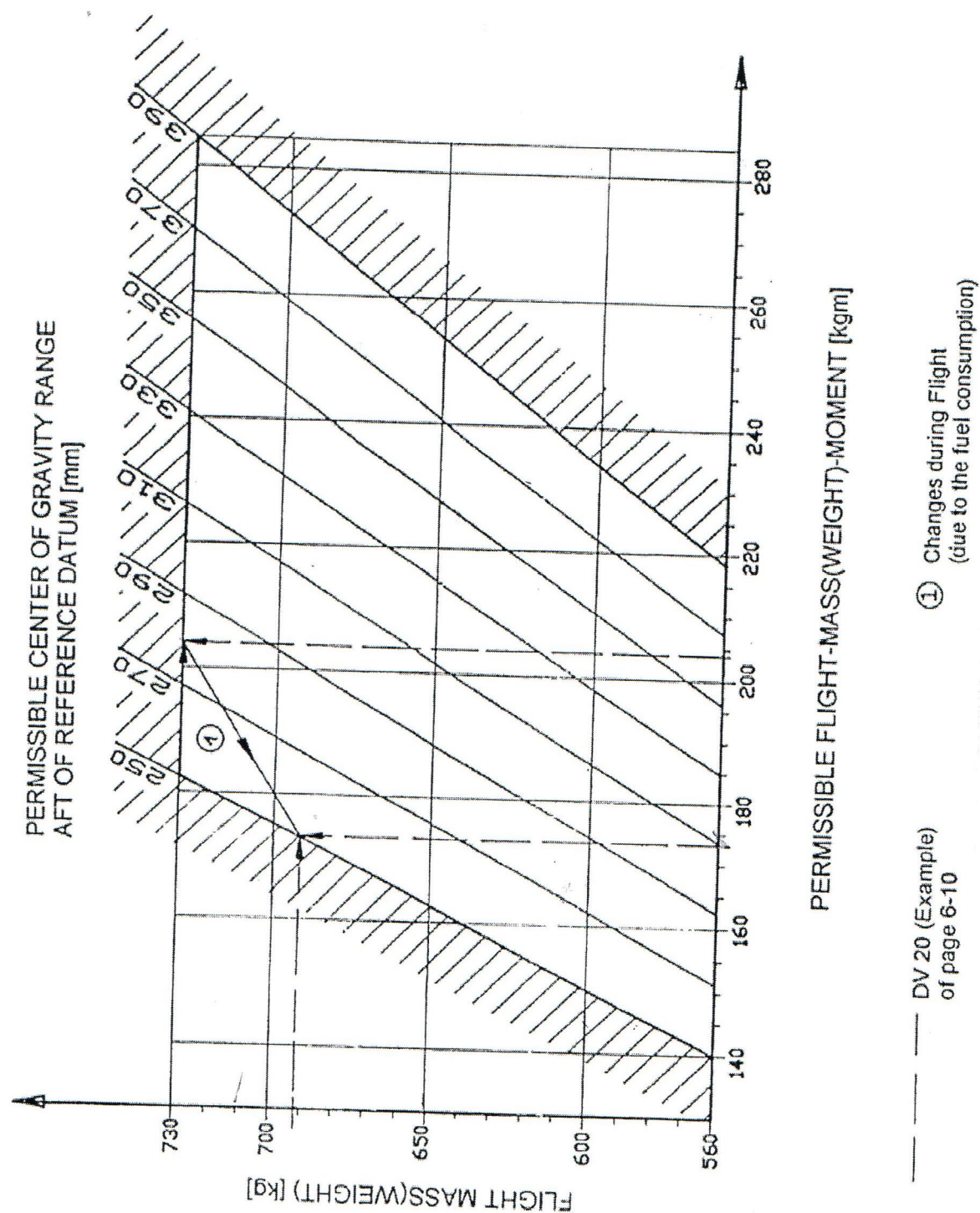


Figure 6.5: Calculation of the Load Limits

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Calculation of the Load Limits	DV 20 (Example)		Your DV 20	
	Mass [kg] (Weight [lbs])	Moment [kgm] ([in.lbs])	Mass [kg] (Weight [lbs])	Moment [kgm] ([in.lbs])
1. Empty Mass(Weight), to be taken from the Mass (Weight) & Balance Report.	520 (1147)	148.404 (12888)	507.6	161.41
2. Pilot and Passenger: Lever Arm: 0.143 m (5.63 in)	172 (380)	24.596 (2112)		
3. Baggage: Lever Arm: 0.824 m (32.44 in)	-- (--)	-- (--)		
4. Total Mass (Weight) and Total Moment with empty fuel tank (add lines 1-3)	692 (1526)	173.000 (15000)		
5. Usable Fuel Load 0.75 kg/liter (6.26 lbs./US gal.) Lever Arm: 0.824 m (32.44 in)	38 (84)	31.996 (2747)		
6. Total Mass (Weight) and Total Moment, taking fuel into account (add 4. and 5.)	730 (1609)	204.996 (17747)		
7. Find the values for the total mass (weight) (692 kg and 730 kg) and the total moment (173 kgm and 205 kgm) in the center of gravity diagram (Fig. 6.4). Since they are within the limitation range, the loading is permissible.				