

UNITED STATES MARINE CORPS  
Logistics Operations School  
Marine Corps Combat Service Support School  
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LS 302

**STUDENT OUTLINE**

**CALCULATE CENTER OF BALANCE FOR A MOTOR VEHICLE**

**LEARNING OBJECTIVES**

1. Terminal Learning Objective: Given a loaded motor vehicle and trailer prepared to load aboard an aircraft, tools and material, to ensure safe and proper embarkation of equipment, calculate center of balance for a motor vehicle in accordance with FMFM 4-6, AMC Pamphlet 36-1. (0481.01.10)
2. Enabling Learning Objective: Given a loaded motor vehicle and trailer prepared to load aboard an aircraft, tools and material, in accordance with the references:
  - a. Weigh each axle of a vehicle. (0481.01.10a)
  - b. Mark vehicle axle weights, gross weight, and center of balance. (0481.01.10b)
  - c. Establish reference datum line at the front axle and measure from the RDL to all axles. (0481.01.10c)
  - d. Compute moments for all axles and divide moments by the total weight to determine center of balance. (0481.01.10d)

**OUTLINE**

**1. WEIGHING AXLES.**

- a. The short mark on the portable scale represents 100 lbs. The large marks on the portable scale represents 1,000 lbs.
- b. All cargo for air shipment must be weighed. Either portable or fixed scales are acceptable. Once weight is marked on the vehicle, do not add or remove any of the cargo. Additions or deletions will require reweighing of the cargo.

c. Vehicles. A minimum of 2 scales will be used when weighing vehicles. Place scales in front of each wheel then have the driver roll the vehicle on top of the scale. The driver must then set the brake and get out of the vehicle. The scales must be centered under the vehicle tires.

d. Trailers. Position one scale in front of each tire. Have the driver pull the trailer onto the scales. Next, set the hand brake. Then disconnect the trailer from the vehicle and set the tongue on a third scale.

e. Maintenance.

(1) In order to keep the wheel scales in working condition you must ensure to store them in a covered area to protect them from various environments. (i.e. snow, rain.)

(2) You should also do periodic checks when using them to ensure there are no cracks on the glass and the handles are not loose.

(3) When reading portable wheel scales, you must ensure that the red line on the glass is aligned to the red line with the 0 on it. It must be aligned to receive an accurate reading. If it is not lined up, use the bronze knob located on the right side of the glass. Turn this knob left or right till the scale is calibrated. If this does not work after a few minutes, refer to your supply section to repair or replace the wheel scales.

## 2. MARKING AXLE WEIGHT.

a. Equipment.

(1) Note pad and pencil/pen.

(2) Calculator.

(3) Wheel scales.

(4) Grease pencil.

(5) Tape.

(6) Measuring tape.

b. Terms for calculating center of balance.

(1) FOH = Front overhang. Distance in inches from front bumper to center of front axle.

(2) WB = Wheelbase. Distance in inches from center of front axle to center of rear axle or center of tandem axles.

(3) ROH = Rear overhang. Distance from rear axle or center of tandem axles to rear bumper.

(4) FAW = Front axle weight.

(5) RAW = Rear axle weight.

(6) GW = Gross weight.

(7) Moment = The product obtained by multiplying an axle weight by the distance (in inches) from the reference datum line (RDL).

c. Front axle. The readings of both scales under the front tires will be added together to get the front axle weight (FAW). Front axle weight will be marked on the fender above the front wheel on each side with a length of masking tape with the letters FAW and the axle weight. The gross weight will be marked on the center of balance marker in the horizontal portion of the "T".

d. Rear axle. Rear axle weights (RAW) will be marked in the same manner as the front axle except that the letters RAW will be used. On tandem vehicles, the weight of all four wheels will be added together to get the rear axle weight and marked on the fender between both wheels.

e. Multi-axle vehicles (GAMA Goat). Middle axle weight will be marked in the same manner as the front axle except that the letters "MAW" will be used.

f. Center of balance. COB will be marked with a "T." Gross weight will be marked on the horizontal portion. COB will be marked on the vertical portion. "T" will be placed at the actual center of balance.

### **3. ESTABLISH REFERENCE DATUM LINE.**

a. RDL = Reference datum line: a predetermined point from which all measurements are taken. Usually, the RDL is taken from the most forward edge of the vehicle.

**4. CALCULATING CENTER OF BALANCE.**

a. Two axles:

W1 = Weight one: W2 = Weight two.

Formula:  $\frac{W1 \times D1 + W2 \times D2}{\text{Gross Weight}} = \text{Center of Balance}$

W1		D1		Moment	
5,000	x	60	=	300,000	Moment 1
W2		D2			
<u>10,000</u>	x	<u>180</u>	=	<u>1,800,000</u>	Moment 2 (Add Moments)
15,000	=	GW		2,100,000	Total Moments

DIVIDE TOTAL MOMENTS BY GROSS WEIGHT.

$$15000 \ / \ \frac{2,100,000}{140}$$

140 INCHES IS THE CENTER OF BALANCE OF THE VEHICLE MEASURED FROM THE RDL. **NOTE: ALWAYS ROUND ANSWER TO NEAREST WHOLE INCH.**

b. Three or more axles: (GAMA Goat)

W1		D1		Moment	
3,000	x	24	=	72,000	Moment 1
W2		D2			
5,300	x	104	=	551,200	Moment 2
W3		D3			
<u>2,400</u>	x	<u>184</u>	=	<u>441,600</u>	Moment 3
10,700	=	GW		1,064,800	Total Moments

DIVIDE TOTAL MOMENT BY GROSS WEIGHT.

$$10,700 \ / \ \frac{1,064,800}{99.5}$$

ALWAYS ROUND ANSWER TO NEAREST WHOLE INCH.

100 INCHES IS THE CENTER OF BALANCE OF THE VEHICLE MEASURED FROM THE RDL.

c. Trailers: (Floodlights, generators)

W1		D1		Moment	
150	x	0	=	0	Moment 1

$$\begin{array}{rclcl} & W2 & & D2 & \\ & 3,600 & \times & 80 & = & \frac{288,000}{288,000} & \text{Moment 2} \\ \frac{3,600}{3,750} = \text{GW} & & & & & & \text{Total Moments} \end{array}$$

DIVIDE TOTAL MOMENT BY GROSS WEIGHT.

$$\frac{76.8}{3750/1,064,800} = 77 \text{ inches}$$

77 inches is the center of balance of the trailer measured from the RDL.

**REFERENCES :**

1. FMFM 4-6
2. AMC PAMPHLET 36-1