

**Chapter 6**  
**Weight and Balance**

**Table of Contents**

General.....	3
Flight Crew Procedures .....	3
Load Adjustments .....	5
Takeoff and Landing Data (TOLD) Card.....	7
Center of Gravity and Weight Range Graph .....	8
Sample Loading Problem .....	8

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## General

This chapter outlines weight and balance procedures for the Cessna 172. The procedures are standardized and can be applied to various aircraft models operated by Bridgewater State College. Where differences exist, those items are identified within this chapter. All pilots will be familiar with and follow the procedures as outlined.

## Flight Crew Procedures

### Cessna 172 Takeoff and Landing Data (TOLD) Card

The Takeoff and Landing Data (TOLD) Card is utilized by flight crewmembers for computing the Zero Fuel Weight, Takeoff Weight, Adjusted Takeoff Weight, and Landing Weight for the aircraft before flight. Instructions for the completion of a TOLD are provided in this chapter.

### Basic Empty Weight

From the dispatched aircraft clipboard “can” enter the basic empty weight, arm, and moment of the aircraft.

<b>NOTE</b>
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If any discrepancies are found between data contained on the “can” and in the AFM in the aircraft, refer to the W/B data included in the Pilot’s Operating Handbook / Airplane Flight Manual. Report any discrepancies between data sources to BSC Dispatch.

<b>NOTE</b>
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The reference datum for the Cessna 172 is the lower portion of the front face of the firewall.

## Pilot & Passengers

Enter the weight of the pilot and front seat passenger. To determine moment, use the following method:

1. Using the Bridgewater State College FSM or the aircraft’s Pilot’s Operating Handbook / Airplane Flight Manual, plot the moment from the Center of Gravity and Weight Range Graph.

## Rear Passengers

Enter the weight of any rear passengers or baggage to be carried in the rear seat, if appropriate. Use the same methods as described in “Pilot & Passengers” to determine the moment.

**Baggage**

Enter weight of any baggage to be stowed in the under-seat baggage area. Use the methods previously described to determine the moment.

**Maximum Weight in Baggage Compartment ..... 120 lbs**

**Zero Fuel Weight**

Determine Zero Fuel Weight and Balance by adding the weights and moments from Basic Empty Weight, Pilot & Passenger, Rear Passengers, and Baggage. Divide moment by weight to determine arm. Determine that the Zero Fuel Weight center-of-gravity is within limits.

**Fuel**

Enter the weight of all useable fuel on board the aircraft. Use either method 1 or 2 to determine the moment.

**Ramp Weight**

Determine Ramp Weight and Balance by adding the weights and moments from Zero Fuel Weight and Fuel. Divide moment by weight to determine arm. Compare the Ramp Weight to the Maximum Ramp Weight found in the Bridgewater State College FSM or the aircraft Pilot’s Operating Handbook / Airplane Flight Manual.

**Start / Taxi / Run-up**

From the Bridgewater State College FSM or aircraft Pilot’s Operating Handbook / Airplane Flight Manual, determine the weight and moment of fuel used during engine start, taxi, and run-up.

**NOTE**

<b>Fuel Burn for Engine Start, Taxi &amp; Run-up</b>	<b>- 7 Lbs.</b>	<b>48.0”</b>	<b>-336 In-Lbs</b>
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**Takeoff Weight**

Subtract the weights and moments from Start / Taxi / Run-up from Ramp Weight. Divide moment by weight to determine arm. Determine whether the aircraft is within Maximum Takeoff Weight and center-of-gravity limits by using the Center-of-Gravity Limits Graph in the Bridgewater State College FSM or the aircraft Pilot’s Operating Handbook / Airplane Flight Manual.

## Load Adjustments

### Passenger

Enter the amount of passenger(s) weight / moment, if appropriate, to be adjusted. Put a plus sign for adding weight / moment or a minus sign to subtract the weight / moment (example +150 or –150 lbs.). Enter a “0” or put a line through the space for no adjustment.

### Baggage

Enter the amount of baggage weight / moment, if appropriate, to be adjusted. Put a plus sign for adding weight / moment or a minus sign to subtract the weight / moment (example +30 or –30 lbs.). Enter a “0” or put a line through the space for no adjustment.

### Fuel

Enter the amount of fuel weight / moment, if appropriate, to be adjusted. Put a plus sign for adding weight / moment or a minus sign to subtract the weight / moment (example +100 or –100 lbs.). Enter a “0” or put a line through the space for no adjustment.

### Adjusted Takeoff Weight

Add and / or subtract all weight(s) / moment(s), if appropriate, to determine the Adjusted Takeoff Weight. Divide moment by weight to determine arm. Determine whether the aircraft is within Maximum Takeoff Weight and center-of-gravity limits by using the Center-of-Gravity Limits Graph in the Bridgewater State College Flight Standards Manual or the aircraft Pilot’s Operating Handbook / Airplane Flight Manual.

### Fuel Burn

Enter the estimated amount of fuel burned weight / moment to complete the flight. See Chapter 5, Performance and the aircraft POH for fuel burn calculations.

### Landing Weight

Subtract the estimated amount of fuel burned weight / moment from the Takeoff Weight or Adjusted Takeoff Weight, as appropriate, to determine the Landing Weight.

### Minimum Fuel Load

Enter Minimum Fuel Load. This is the minimum amount of fuel, including reserves, required to complete the flight.

## **WARNING**

**No pilot may commence a flight if the aircraft is unable to carry the minimum fuel load required for the flight.**

**NOTE**

Loading form information is based on seats positioned for *average* occupants and baggage loaded in the center of the baggage area as shown on the loading form sample problem. For different loading conditions, additional moment calculations based on the *actual weight and C.G. arm* (fuselage station) must be made. Total weights and moments and determine the values.

**Take Off and Landing Data (TOLD) Card**  
(Weight and Balance Only)

<b>Cessna 172 Takeoff and Landing Data (TOLD) Card</b>			
<b>Weight and Balance Data</b>			
	<b>WEIGHT</b>	<b>ARM</b>	<b>MOMENT</b>
<b>Basic Empty Weight</b>	_____	_____	_____
Pilot and Passenger	_____	_____	_____
Rear Passengers	_____	_____	_____
Baggage (120 lbs. max)	_____	_____	_____
<b>Zero Fuel Weight</b>	_____	_____	_____
Fuel	_____	_____	_____
Ramp Weight	_____	_____	_____
Start/Taxi/Run-up (-7 lbs fuel)	_____	_____	_____
<b>Takeoff Weight</b> 2450 Nor./2100 Util.	_____	_____	_____
Load Adjustments	_____	_____	_____
Passenger	_____	_____	_____
Baggage (120 lbs. max)	_____	_____	_____
Fuel	_____	_____	_____
<b>Adjusted Takeoff Wt</b>	_____	_____	_____
Fuel Burn	_____	_____	_____
<b>Landing Weight</b>	_____	_____	_____
<b>Minimum Fuel Load _____ Gallons</b>			

### Center of Gravity Range

<b>NORMAL CATEGORY</b>	
<b>Forward:</b>	<b>35.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 40.0 inches aft of datum at 2450 lbs.</b>
<b>Aft:</b>	<b>47.3 inches aft of datum at all weights.</b>
<b>UTILITY CATEGORY</b>	
<b>Forward:</b>	<b>35.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 36.5 inches aft of datum at 2100 lbs.</b>
<b>Aft:</b>	<b>40.5 inches aft of datum at all weights.</b>

### Sample Weight and Balance Problem

	SAMPLE AIRPLANE			BSC AIRPLANE		
	WEIGHT (lbs)	ARM (in)	MOMENT (lb.-in. /100)	WT (lbs)	ARM (in)	MOMENT (lb.-in. /100)
<sup>1</sup> Basic Empty Wt	1639	29.3	64.4			
Fuel (40 gal) (53 gal. max)	240	48.0	11.52		48.0	
Pilot / Co-Pilot	340	37.0	12.6		37.0	
Rear Psngr(s)	180	73.0	13.14		73.0	
<sup>2</sup> Baggage Area 1	20	95.0	1.90		95.0	
Baggage Area 2	-	-	-		108.0	
Ramp Weight	2419	42.8	103.56			
<sup>3</sup> Start, Taxi, Runup	-7	48.0	-.336		48.0	
Takeoff Weight	2412	42.7	103.224			

- <sup>1</sup> Includes 40 pounds optional equipment.
- <sup>2</sup> Maximum allowable: 120 lbs if CG is within Center of Gravity envelope.
- <sup>3</sup> Fuel for start, taxi, and run-up is normally 7 lbs at an average moment (lb.-in./100) of 3.36.