

**CHAPTER 3  
PREFLIGHT ACTION**

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## **GENERAL**

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Preflight action, weight and balance and performance information for the BSU Piper Arrow PA28R200 is contained within this chapter. The information contained within these chapters *must be combined with the information provided in the Performance section of the appropriate aircraft POH* to calculate the necessary performance data for normal operations. It also provides specific performance factors to be considered during abnormal and emergency operations.

Included are representative examples, demonstrating proper use of the charts and / or tables. Both chapters are arranged in the order most typically used by the flight crew (i.e.: preflight, planning, execution, etc.).

Performance information associated with optional systems and equipment is provided in Section 9 (Supplements) of the Pilot's Operating Handbook / Airplane Flight Manual.

The performance information presented in this chapter is based on measured flight test data corrected for I.C.A.O. standard day conditions and analytically expanded for the various parameters of weight, altitude, temperature, etc. Performance charts in the aircraft POH are not factored and do not make any allowance for varying degrees of pilot proficiency or mechanical deterioration of the aircraft.

### **Preflight Action Philosophy**

The meaning of Preflight Action encompasses obtaining all of the information required for a particular flight. It includes, but is not limited to, obtaining a proper flight/weather briefing, calculating weight and balance and performance, complying with all regulations, including but not limited to FAR 91.103, determining aircraft airworthiness and inoperative equipment, if any. A systematic approach to preflight action will produce the best results in the shortest possible time, allowing for safe, efficient and timely aircraft departure and operation.

Effects of conditions not considered on the charts must be evaluated by the flight crew, such as the effects of a soft or grass runway surface on takeoff and landing performance, or the effect of winds aloft on cruise and range performance. Endurance can be grossly affected by improper leaning procedures, and in flight fuel flow and quantity checks are recommended.

The information included in this chapter provides the procedures necessary to complete a Bridgewater State University Takeoff Data Card and Flight Plan Form. The performance charts in the aircraft POH include examples to show how to calculate relevant flight information.

#### **NOTE**

The following side-by-side TOLD card is provided for the convenience of the pilot and should be printed as necessary.



## Piper PA28R200 Arrow Takeoff & Landing Data Card

Student: \_\_\_\_\_ Instructor: \_\_\_\_\_ Date: \_\_\_\_\_

Aircraft N # _____	Departure Information	Arrival Information
Winds		
Visibility		
Ceilings (AGL)		
Temperature/Dew Point		
Local Altimeter		
Active Runway(s)		
Density Altitude		
Pressure Altitude		
Runway Length Available		
Headwind Component		
Crosswind Component		
Tailwind Component		
<b>Aircraft Performance Data</b>		
Runway: PAVED DIRT GRASS Condition: DRY WET SNOW ICE		
Normal TO Distance (Ground Roll) _____	Distance over 50' obstacle : _____	
Short Field TO Distance (Ground Roll) _____	Distance over 50' obstacle : _____	
Max. aborted takeoff distance _____		
(takeoff ground roll + landing ground roll+30% safety margin)		
Initial Climb Rate: _____ FPM		
Landing Distance (Ground Roll) _____	Distance over 50' obstacle : _____	
V <sub>SO</sub> _____ V <sub>A</sub> _____	V <sub>LO (up)</sub> _____ V <sub>LO (down)</sub> _____	
V <sub>SI</sub> _____ V <sub>FE</sub> _____	V <sub>LE</sub> _____	
V <sub>X</sub> (gear down) _____ V <sub>X</sub> (gear up) _____	V <sub>NO</sub> _____ App/Landing Speed(s) _____	
V <sub>Y</sub> (gear down) _____ V <sub>Y</sub> (gear up) _____	V <sub>BE</sub> _____ Best Glide _____	



## Piper PA28R200 Arrow Takeoff & Landing Data Card

### Weight and Balance Data

	WEIGHT	ARM	MOMENT
<b>Basic Empty Weight</b>			
Pilot and Passenger	_____	_____	_____
Rear Passengers (or back seat baggage)	_____	_____	_____
Rear Baggage Area (200 lbs max)	_____	_____	_____
<b>Zero Fuel Weight</b>			
Fuel	_____	_____	_____
Ramp Weight	_____	_____	_____
Start/Taxi/Run-up (-8 lbs fuel)	_____	_____	_____
<b>Takeoff Weight</b> (2650 lbs maximum)			
<i>Load Adjustments:</i>			
Front Passenger	_____	_____	_____
Rear Passenger(s)	_____	_____	_____
Baggage	_____	_____	_____
Fuel	_____	_____	_____
Gear Retraction	XXXX	XXXX	+819
<b>Adjusted Takeoff Wt</b>			
Fuel Burn	_____	_____	_____
Landing Weight	_____	_____	_____
Minimum Fuel Load _____ Gallons			

## ***FLIGHT / WEATHER BRIEFING***

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### **Flight / Weather briefing philosophy**

While often referred to as the “Weather” briefing for the sake of brevity, the correct way to think about the official briefing is as a Flight briefing. While weather is and will remain the main component of the briefing, there are many other flight safety related items contained in a standard briefing that are unrelated to the weather. Regulations require pilots to be familiar with ALL available information. The only official source of such information is obtaining an official Flight / Weather briefing.

Even in situations where there is absolutely no adverse weather of any kind (clear, unlimited visibility, no ceiling and calm winds) obtaining an official briefing will help the pilot to avoid, for example, situations like the following:

- 1) Flying through a TFR without following proper procedures
- 2) Diverting to a closed airport
- 3) Running into a new unmarked obstruction
- 4) Attempting to use a navaid that is removed for maintenance
- 5) Landing on a closed runway
- 6) Executing an obsolete air traffic procedure
- 7) Any other unpleasant situation that might be known to the briefer, but not the pilot

Even the most current (unexpired) charts and publications are potentially outdated the minute they come out. One must obtain the most current information, and the only way to ensure it is to obtain an official Flight and Weather briefing from a certified source.

### **Official vs. unofficial sources**

While there are many sources of Flight and Weather information, most of these sources are, while extremely useful, yet unofficial. That means the DELIVERY method cannot be guaranteed, and there is no official RECORD created that a briefing has been received. While one may obtain information from these sources in ADDITION to the official sources, one may never replace the official sources with unofficial sources, no matter how similar the information presented seems to be.

The two methods of obtaining an official Flight and Weather Briefing are verbally (in person or over the phone, and in the air) or electronically, via DUATS or a similar certified system. There is an official record created that a briefing has been obtained. A useful way to think about it is that, in aviation, if there is no proper record of an event, then it did not take place.

To obtain an official briefing over the phone, any individual with a Pilot certificate (including student pilots) can dial 1-800-WX-BRIEF to contact a Flight Service specialist. In the air, pilots can contact Flight Service Stations over the radio for essentially the same information, should an updated briefing become necessary.

To obtain an official weather briefing electronically via DUATS, one can use the Internet or other certified electronic methods. The two distinct FAA certified DUATS vendors can be found at [www.duat.com](http://www.duat.com) and [www.duats.com](http://www.duats.com)

One advantage of obtaining a briefing over the phone or in person with a live briefing specialist is that you get the briefer's judgment, in addition to the flight and weather information.

One advantage of obtaining a briefing electronically is that it is a fast method of delivery that puts all the information in front of the pilot, who can then spend as much time as necessary looking at the information.

Detailed discussion of Flight /Weather briefing procedures is beyond the scope of this manual. Consult the appropriate official publications. You may also refer to the following FAA link: <http://www.hf.faa.gov/weatherdecisionguide/preflight.aspx>

Note: The above link is current as of this writing, but links may change frequently. Another way to arrive to the same document is to search [www.faa.gov](http://www.faa.gov) for the following keywords: weather guide.

## ***WEIGHT and BALANCE***

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This section outlines weight and balance procedures for the BSU Piper PA28R200. This section is provided only to SUPPLEMENT the official Weight and Balance section in the Piper PA28R200 POH / AFM, and is not intended to replace it. Refer to the POH / AFM for additional information.

### **Flight Crew Procedures**

#### **Piper PA28R200 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 (BEW), arm, and moment of the aircraft in the TOLD card. That information can also be obtained from the aircraft list, available in the briefing room, should the aircraft “can” not be presently available.

#### **NOTE**

If any discrepancies are found between data contained on the “can” and in the Pilot’s Operating Handbook (POH) / Approved Airplane Flight Manual (AFM) in the aircraft, refer to the W/B data included in the AFM. Report any discrepancies between data sources to BSU Dispatch.

#### **Pilot & Passengers**

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

1. Using the Bridgewater State University FSM and the aircraft’s POH / AFM, multiply the total weight of the pilot and the passenger by the arm location.
2. The arm locations are found in Weight and Balance, Section 6, Loading Arrangements, of the POH / AFM.

#### **Rear Passengers / Baggage in back seat**

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 in baggage areas**

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

**Maximum Weight in Rear Baggage Compartment.....200 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, converting from gallons to pounds. Multiply the weight of the fuel by the arm, using previously described method, 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 University FSM or the aircraft Pilot’s Operating Handbook / Airplane Flight Manual.

**Start / Taxi / Run-up**

From the Bridgewater State University 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>Weight - 8 Lbs.</b>	<b>Arm 95.0”</b>	<b>Moment - 760 In-Lbs</b>

**Takeoff Weight**

Subtract the weight and moment 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 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 Center of Gravity Change Due to Nose Gear Retraction**

Moment change due to retracting landing gear: +819 inch/lbs. Enter the Takeoff Weight (or Adjusted Takeoff Weight) in the Weight Column. Then enter +819 as a change to the moment in the Moment Column. Divide moment by weight to determine arm.

### **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 University Flight Standards Manual or the aircraft Pilot's Operating Handbook / Airplane Flight Manual.

### **Fuel Burn**

Enter the estimated weight and moment for fuel burned to complete the flight. See Performance section of the aircraft POH / AFM 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 required minimum fuel load, including reserves.**

## **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 all weights and moments and determine the values.

Ensure that when subtracting weight, the resulting moment used in calculations is negative.

$$\text{Weight} \times \text{Arm} = \text{Moment}$$

$$\text{Aircraft Weight} \times \text{CG} = \text{Aircraft moment}$$

$$\text{CG} = \text{Aircraft Moment} / \text{Aircraft Weight}$$

**REMEMBER: You can add and subtract WEIGHTS and MOMENTS, but never ARMS!**

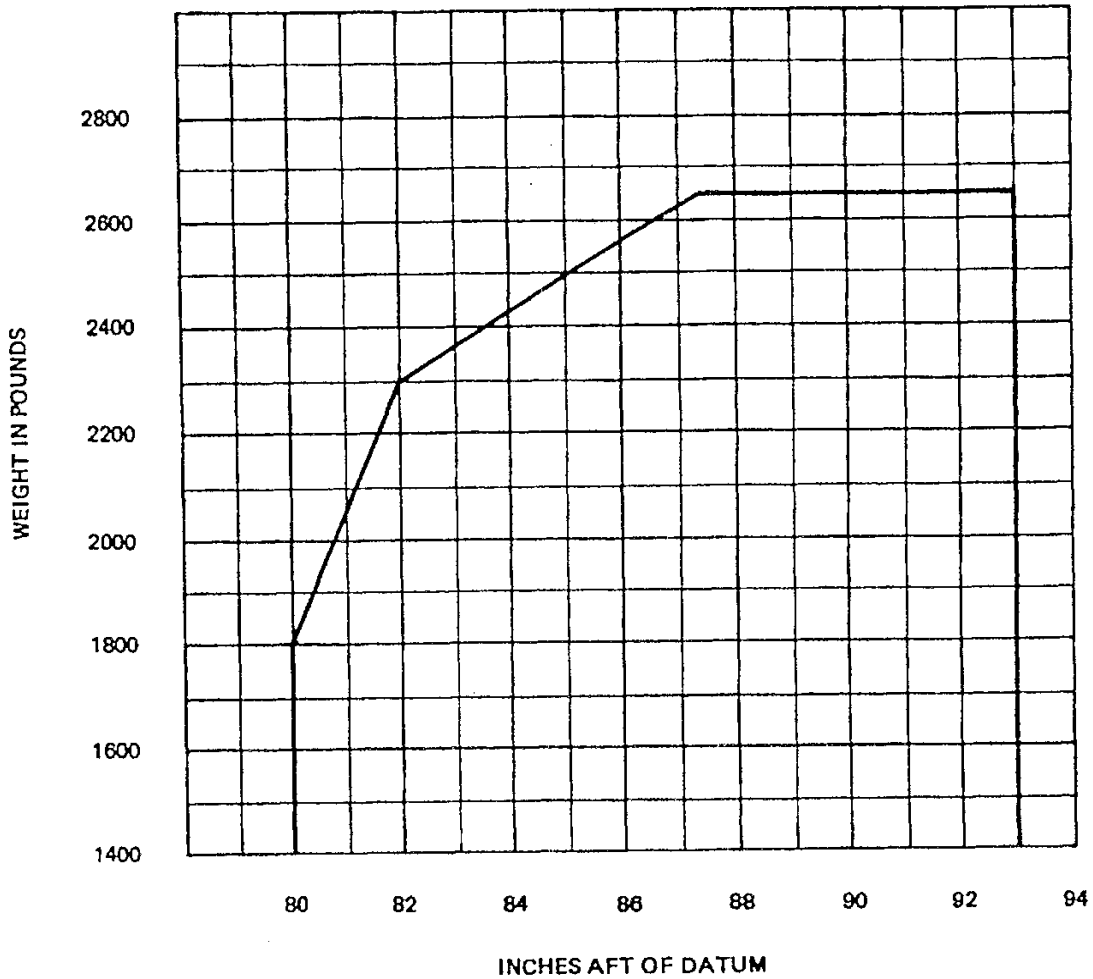


<b>Piper PA28R200 Takeoff and Landing Data (TOLD) Card</b>			
<b>Weight and Balance Data</b>			
	<b>WEIGHT</b>	<b>ARM</b>	<b>MOMENT</b>
<b>Basic Empty Weight</b>	_____	_____	_____
Pilot and Passenger	_____	_____	_____
Rear Passengers (or back seat baggage)	_____	_____	_____
Rear Baggage Area (200 lbs max)	_____	_____	_____
<b>Zero Fuel Weight</b>	=====	=====	=====
Fuel	_____	_____	_____
Ramp Weight	_____	_____	_____
Start/Taxi/Run-up (-8 lbs fuel)	_____	_____	_____
<b>Takeoff Weight (2650 lbs maximum)</b>	=====	=====	=====
<i>Load Adjustments:</i>			
Front Passenger	_____	_____	_____
Rear Passenger(s)	_____	_____	_____
Baggage	_____	_____	_____
Fuel	_____	_____	_____
Gear Retraction	<b>XXXX</b>	<b>XXXX</b>	<b>+819</b>
<b>Adjusted Takeoff Wt</b>	=====	=====	=====
Fuel Burn	_____	_____	_____
<b>Landing Weight</b>	_____	_____	_____
<b>Minimum Fuel Load _____ Gallons</b>			

**Center-of-Gravity Range and Weight**

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**C. G. RANGE AND WEIGHT**



MOMENT DUE TO RETRACTING LANDING GEAR = +819 IN - LBS

### Sample Weight and Balance Problem

	SAMPLE AIRPLANE			BSU AIRPLANE		
	WEIGHT	ARM	MOMENT	WT	ARM	MOMENT
	(lbs)	(in)	(lb.-in. )	(lbs)	(in)	(lb.-in. )
Empty Weight	1631	83.7	136,515			
Fuel (48 gal max. x 6 lbs/gal)	288	95.0	27,360		95.0	
Pilot / Co-Pilot	340	80.5	27,370		80.5	
Rear Psngr(s)	180	118.1	21,258		118.1	
Rear Baggage Area	20	142.8	2,856		142.8	
<b>Ramp Weight</b>	<b>2,459</b>	<b>87.6</b>	<b>215,359</b>			
Start, Taxi, Runup	-8	95.0	-760		95.0	
<b>Takeoff Weight</b>	<b>2,451</b>	<b>87.6</b>	<b>214,599</b>			

Note: Fuel for start, taxi, and run-up is normally 1.2 gallons, or 8 lbs at an average moment (lb.-in) of 760.

In this example, the center of gravity (C.G.) for TAKEOFF WEIGHT of 2,451 lbs is at 87.6 inches aft of the reference datum. Using the CG Range and Weight Graph, locate the 87.6 inches on the C.G. range scale and locate the weight (2,451 lbs) on the weight scale. Since the point where they intersect is well within the weight – C.G. envelope, this loading meets the weight and balance requirements.

## ***PERFORMANCE***

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### **Performance side of the Takeoff and Landing Data (TOLD) Card**

This section provides step-by-step instructions for completing the aircraft performance side of the Bridgewater State University Takeoff and Landing Data (TOLD) Card.

#### **NOTE**

Altering the date on a previously used TOLD card is unacceptable.  
A new TOLD card shall be completed for each aircraft and each flight.

#### **Pilot / Instructor / Date**

Enter last name of the Pilot and Instructor, and date of the flight event. Ensure both pilot names (if appropriate) are on the card for non-instructional flights.

#### **ATIS Code**

Enter the current ATIS code, if available.

#### **Active Runway**

Enter the runway in use as obtained from any valid current report (ATIS, Common Traffic Advisory Frequency (CTAF), UNICOM, Flight Service Station (FSS)).

#### **Winds**

Enter current surface winds from any current valid report (ATIS, automated weather reports (ASOS or AWOS), UNICOM, FSS). If METAR is used in lieu of other sources, ensure that the winds are converted from TRUE to MAGNETIC for proper determination of the angle between the runway and the wind.

#### **Ceiling / Visibility**

Enter the ceiling and visibility from any current valid report (ATIS, automated weather reports (ASOS or AWOS), Pilot Report (PIREP), FSS)

#### **Temperature**

Enter the surface temperature from any current valid report (ATIS, automated weather reports (ASOS or AWOS), UNICOM, FSS).

#### **Dewpoint**

Enter the dewpoint from any current valid report (ATIS report, automated weather reports (ASOS or AWOS), FSS).

#### **Altimeter Setting**

Enter the altimeter setting (in inches Hg) from any current valid report (ATIS, automated weather reports (ASOS or AWOS), UNICOM, FSS). If a current local altimeter setting is not available, use departure airport elevation.

### **Pressure Altitude**

Calculate and enter takeoff pressure altitude.

#### **NOTE**

The following two-step formula may be used to determine pressure altitude.

$$(29.92 - CA) \times 1000 = X$$

$$X + FE = PA$$

Where:

X – intermediate conversion factor

CA – Current Altimeter Setting

FE – Field Elevation

PA – Pressure Altitude

### **Density Altitude**

With the values of pressure altitude and surface temperature, calculate and enter density altitude.

#### **NOTE**

The following formula may be used to determine density altitude.

$$PA + 120(CT - ST) = DA$$

Where:

PA – Pressure Altitude, as calculated in previous step

CT – Current Surface Temperature (°C)

ST – Standard Temperature (°C) FOR YOUR AIRPORT ELEVATION (15° C at Sea level, then decreasing at a standard lapse rate of 2° per 1,000' elevation increase)

DA – Density Altitude

### **Runway Length**

Enter the lengths, at the departure and arrival airports, of runways of intended use. Obtain this information from the Airport / Facility Directory or other appropriate publication. Ensure that there is sufficient runway available at all airports for the planned flight.

### **Headwind, Crosswind, and Tailwind Components**

It is essential to calculate and enter the headwind, crosswind, and tailwind components to ensure that BSU, flight crew, and aircraft limitations will not be exceeded. Use the appropriate performance graphs in the POH / AFM.

## **Aircraft Performance Data**

This section of the TOLD Card includes takeoff, runway, cruise, landing, and V speeds.

### **Runway Condition (Contamination)**

Enter the current (departure) runway information. For arrival, enter the expected runway condition. More information on runway contamination is provided later in this chapter.

### **Takeoff distance (Ground Roll and over 50' obstacle)**

Insert the takeoff distance calculated by utilizing the Takeoff Distance performance chart in the POH/AFM. Calculate both Ground Roll and Distance over 50' obstacle.

### **Maximum Aborted Takeoff Distance**

Insert the distance calculated by adding the ground roll for both takeoff and landing, and then adding a safety margin of 30% of the total. This is the maximum distance that may be needed to stop safely if an aborted takeoff is initiated at the moment of rotation. Compare this distance to the runway available and plan accordingly.

### **Initial Climb Rate (FPM – Feet per minute)**

Insert the initial climb rate expected after takeoff, as calculated from the POH / AFM chart. This number is a valuable indicator of determining if the aircraft can clear surrounding terrain safely after leaving the runway.

### **Landing Distance (Ground Roll and over 50' obstacle)**

Insert the landing distance calculated by utilizing the Landing Distance performance chart in the POH. Calculate both Ground Roll and Distance over 50' obstacle.

## **V Speeds**

Refer to the POH/AFM. Writing these down on the TOLD card just prior to a flight serves as an excellent review of the memorized V speeds needed to safely operate the aircraft.

- V<sub>S0</sub>** Stalling speed or the minimum steady flight speed in the landing configuration.
- V<sub>S1</sub>** Stalling speed or the minimum steady flight speed in a specified configuration.
- V<sub>R</sub>** Rotation speed (varies with the weight of the aircraft).
- V<sub>X</sub>** Best angle of climb airspeed (i.e. the airspeed that delivers the greatest gain in altitude in the shortest possible horizontal distance, regardless of time).
- V<sub>Y</sub>** Best rate of climb airspeed (i.e. the airspeed that delivers the greatest gain in altitude in the shortest possible time, but at a shallower angle).
- V<sub>FE</sub>** Maximum flap extended speed (i.e. the highest airspeed permissible with the wing flaps in a prescribed extended position).

- V<sub>LO</sub>** Maximum landing gear operating speed (i.e. the highest speed you can retract or extend the gear. For the PA28R200, there are two different speeds, one for gear retraction and another for gear deployment.)
- V<sub>LE</sub>** Maximum gear extended speed (i.e. the highest airspeed permissible with landing gear in the extended position).
- V<sub>A</sub>** Maneuvering speed (i.e. the maximum speed at which application of full available aerodynamic control will not overstress the aircraft). V<sub>A</sub> decreases at lighter weights. Calculate and insert V<sub>A</sub> for the *lightest* weight that will be encountered during the flight, that is, the landing weight. A lower V<sub>A</sub> calculated for the landing weight will be safe for both the takeoff weight and the landing weight, while a higher V<sub>A</sub> calculated for the takeoff weight will not. Consequently, the *lowest* V<sub>A</sub> must be used throughout the flight.

**NOTE**

The following formula may be used to determine the actual V<sub>A</sub> for your current weight.

$$V_A \text{ (at actual weight)} = V_A \text{ (at max weight)} \times \text{SQRT (actual weight / max weight)}$$

Or, for example

$$V_A \text{ (at actual weight)} = 131 \times \text{SQRT (actual weight / 2650)}$$

Where:

SQRT implies you must take a square root of the variables inside the parentheses

- V<sub>NO</sub>** Maximum structural cruising speed. Do not exceed this speed except in smooth air, and then only with caution.
- V<sub>NE</sub>** Never exceed speed. Do not exceed this speed at any time.

**Approach / Landing Speed(s)**

Speeds that must be used for the approach and landing portion of the flight. For instrument approaches both the approach speed and the landing speed must be listed.

**Best Glide Speed (Flaps up)**

Insert the best glide speed (speed that will give you maximum forward distance travelled for any given altitude loss, ) with the engine inoperative and the flaps up. Consult POH/AFM for more information.

## Piper PA28R200 Arrow Takeoff & Landing Data Card (Performance)

**Student:** \_\_\_\_\_ **Instructor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

Aircraft N # _____	Departure Information	Arrival Information
Winds		
Visibility		
Ceilings (AGL)		
Temperature/Dew Point		
Local Altimeter		
Active Runway(s)		
Density Altitude		
Pressure Altitude		
Runway Length Available		
Headwind Component		
Crosswind Component		
Tailwind Component		
<b>Aircraft Performance Data</b>		
Runway: PAVED DIRT GRASS Condition: DRY WET SNOW ICE		
<b>Normal</b> TO Distance (Ground Roll) _____ Distance over 50' obstacle : _____		
<b>Short Field</b> TO Distance (Ground Roll) _____ Distance over 50' obstacle : _____		
Max. aborted takeoff distance _____ (takeoff ground roll + landing ground roll+30% safety margin)		
Initial Climb Rate: _____ FPM		
Landing Distance (Ground Roll) _____ Distance over 50' obstacle : _____		
V <sub>SO</sub> _____ V <sub>A</sub> _____ V <sub>LO (up)</sub> _____ V <sub>LO (down)</sub> _____		
V <sub>S1</sub> _____ V <sub>FE</sub> _____ V <sub>LE</sub> _____		
V <sub>X (gear down)</sub> _____ V <sub>X (gear up)</sub> _____ V <sub>NO</sub> _____ App./Landing Speed(s) _____		
V <sub>Y (gear down)</sub> _____ V <sub>Y (gear up)</sub> _____ V <sub>NE</sub> _____ Best Glide _____		



## Flight Planning Example

### NOTE

Refer to the Piper PA28R200 POH / AFM to locate the charts and graphs used in the required performance calculations.

### Aircraft Loading

Begin by calculating the aircraft weight and center of gravity by utilizing the information provided in this chapter.

The Basic Empty Weight (BEW) for the aircraft is determined by the manufacturer and entered in the aircraft Pilots Operating Handbook / FAA Approved Airplane Flight Manual. Verify that any alterations to the aircraft that affect the weight and balance have been properly noted in the FAA Approved Airplane Flight Manual, weight and balance record in the aircraft logbook, or the inspection summary in the Bridgewater State University aircraft “can”.

### NOTE

The weight and balance summary in the Bridgewater State University aircraft can is NOT the official aircraft weight and balance record. Official weight and balance data can be located in the FAA approved Airplane Flight Manual issued for the specific aircraft.

Determine the actual fuel weight, if the aircraft is available, before starting additional weight and balance calculations. Use the best available information if an assumed fuel load is used in the event the aircraft is not on the ramp. Then, ensure that the aircraft actual fuel load is in accordance with the earlier expectations.

The following loading example uses randomly picked data.

1. Basic Empty Weight (for the aircraft you will use)	1,631 lbs
2. Occupants ( typically, CFI and student,2x170 lbs)	340 lbs
3. Baggage and Cargo	341 lbs
4. Fuel (6 lbs x 48 gal)	288 lbs
5. Takeoff Weight	2,600 lbs
6. Fuel burn (30 gallons x 6 lbs/gal)	-180 lbs
7. Landing Weight	2,470 lbs

The takeoff weight is below the maximum of 2,650 lbs, and the weight and balance calculations have determined the C.G. position within the approved limits, by consulting the chart in the POH / AFM.

**Takeoff and Landing**

After determining the aircraft loading, the pilot must carefully consider and calculate expected takeoff and landing performance. Current and forecast conditions at the departure and destination airport(s) must be evaluated and updated throughout the flight.

Perform landing distance calculations in the same manner using current or forecast conditions at the destination airport. Calculate landing distances only <after> calculating expected landing weight.

Apply the departure airport density altitude conditions and takeoff weight to the appropriate Takeoff Performance and Takeoff Ground Roll graphs in the aircraft POH / AFM. This will determine the takeoff ground roll and takeoff ground roll over a 50 ft. barrier.

Note that the performance charts depict values for an aircraft at maximum gross weight 2650 lbs, on a paved level dry runway surface. For both the ground roll and the distance of the 50 ft. obstacle, two figures are provided, depending on whether normal procedure or short field procedure is used. **Ensure that the correct graph line is used for the appropriate procedure and flap setting.** The actual numbers for either procedure could be higher. *A good operating practice is to have at least 20% safety margin above the actual distances calculated.*

Perform the landing distance calculations in the same manner using the existing or forecasted conditions (as appropriate) at the destination airport once the landing weight has been established using the appropriate table(s). Note that the performance chart depicts values for an aircraft at maximum gross weight 2650 lbs, on a paved level dry runway surface, and *executing a short-field landing procedure*. Note also that the Landing Distance chart depicts a landing performed with full flaps. *A good operating practice is to have at least 20% safety margin above the actual distances calculated.*

The conditions for the example flight are listed below.

	<b>Takeoff Airport</b>	<b>Landing Airport</b>
1. Airport elevation	Sea level (0' MSL)	1,000' MSL
2. Pressure Altitude	1000 ft.	2000 ft.
3. Temperature	28°C	25°C
4. Runway Length Available	3500 ft.	3000 ft.
5. Ground Roll	≈ 1400 ft. (normal t/o)	≈ 880 ft.
6. Distance to clear 50' Obstacle	≈ 2400 ft. (normal t/o)	≈ 1450 ft.
7. Initial climb rate (FPM)	≈ 750 FPM	n/a
8. Maximum aborted takeoff dist.	≈ 2,925 ft.	n/a

**NOTE**

The previous example does not include an additional takeoff / landing distance safety margin as stated earlier. The necessary safety margin must be considered by the pilot, taking into account all available information.

The performance charts used in this example assume zero winds. Winds aloft must be considered when computing climb, cruise and descent performance.

When calculating performance involving airspeeds, distances and wind speeds, do not forget to convert different values from KNOTS to MPH and vice versa, as appropriate. The POH charts and graphs often utilize °F instead of °C temperatures, so appropriate conversion must also be made.

**Climb**

Determine climb performance (time, distance, fuel burn):

- 1) Determine density altitude and rate of climb values for the desired cruise pressure altitude and corresponding cruise outside air temperature,
- 2) Determine density altitude and rate of climb at the departure field, as above.
- 3) Using average climb rate, determine total time in the climb from the difference between cruise altitude and the field elevation.
- 4) Using approximately **14 gal/hr fuel flow and 110 MPH cruise climb**, calculate fuel required for the climb, and no-wind climb distance. Don't forget to account for the engine start/taxi/runup allowance in the total fuel calculations.
- 5) The above steps will thus provide approximate time, fuel and distance to climb figures, accounting for density altitude but **not the wind**.
- 6) Using appropriate climb winds and estimates TAS, calculate groundspeed and actual distance in the climb.

These example numbers are calculated using the above instructions and the appropriate graphs in the POH.

- |                                                                               |                              |
|-------------------------------------------------------------------------------|------------------------------|
| 1. Cruise Pressure Altitude                                                   | 4000 ft                      |
| 2. Cruise OAT                                                                 | 10°C (50°F)                  |
| 3. Total Fuel to Climb (1.4 gal actual climb plus ≈1.4 gal for taxi/runup/to) | ≈ 2.8 gal                    |
| 4. Time to Climb                                                              | ≈ 6 min                      |
| 5. Distance to Climb (no wind)                                                | ≈11 statute miles (≈ 9.5 NM) |

**Descent**

Descent planning is often overlooked in localized training operations, but it must be calculated prior to determining cruise flight total distance for extended flights.

- 1) Use the cruise pressure altitude and the OAT to determine % power, TAS and fuel consumption in the descent.
  - a. Assuming cruise fuel consumption during the descent will provide a safety margin
- 2) Subtract the field pressure altitude at the destination airport to determine altitude difference
- 3) Calculate approximate **time** in the descent by dividing the altitude difference by the desired descent rate
  - a. Alternatively, one may desire to begin descent at a certain point/ distance away from the airport, in which case, knowing the groundspeed and the distance, required time to descend and the resulting descent rate can be calculated
- 4) If there is wind, use the TAS and the E6B to determine GS
- 5) Using (time x speed = distance) formula and the GS, or the E6B, determine total **distance** in the descent.
- 6) Using ( time x fuel consumption rate = fuel quantity ) formula, or the E6B, determine total descent fuel consumption

The following figures were determined using the above instructions:

- |                                                                         |                             |
|-------------------------------------------------------------------------|-----------------------------|
| 1. Vertical speed descent profile                                       | - 500 fpm                   |
| 2. Total altitude to descent (cruise altitude to field elevation)       | 3,000 ft                    |
| 3. Total Descent Time                                                   | 6 min.                      |
| 4. Descent airspeed (TAS/GS, no wind)                                   | 150 MPH (130 KNOTS)         |
| 5. Total Distance in Descent                                            | ≈15 statute miles (≈ 13 NM) |
| 6. Descent Fuel Consumption (cruise GPH at 65% to assure safety margin) | ≈ 1.0 gal                   |

### **Cruise**

- 1) Find the total distance in cruise
  - a. From the total flight distance between airports, subtract the previously calculated distances in the climb and in the descent.
  - b. The remaining figure is the total cruise flight distance.
- 2) Calculate cruise performance using the POH / AFM graphs and charts
  - a. Estimate % power using the Power Setting Table Chart
  - b. Determine density altitude at cruise using Altitude Conversion Chart
  - c. Determine TAS on TAS vs. Density Altitude Chart using the % power and density altitude
  - d. Determine the cruise fuel flow (aka fuel consumption rate) using the % power on Range vs. Density Altitude Chart
- 3) If there is wind, use the E6B and the TAS to find GS
- 4) Using (time x speed = distance ) formula and the GS, or the E6B, determine total cruise flight time.
- 5) Using ( time x fuel consumption rate = fuel quantity ) formula, or the E6B, determine total cruise fuel consumption

The following flight planning example utilizes the above steps and previously found figures.

1. Total Distance, airport to airport	345 statute miles (300 NM)
2. Distance in climb +descent (previously calculated)	26 statute miles ( 23 NM)
3. Cruise distance only	319 statute miles (277 NM)
4. Cruise Power (Economy)	65% power
5. Cruise Speed (TAS/GS, no wind)	150 MPH (130 Knots)
6. Cruise Fuel Consumption (at 65% power )	9.2 GPH (consider rounding up)
7. Cruise segment time only	2.3 hours
8. Cruise segment fuel only	21.2 gallons

### **Total Flight Time**

Determine total flight time:

- 1) Add the time to climb and time to descend to cruise flight time.
  - a. Remember to convert time in minutes to time in hours for all calculations.

Total Flight Time (0.1 climb + 2.3 cruise + 0.1 descent) 2.5 hours

### **Total Fuel Required**

Determine total fuel required ( in gallons):

- 1) Add fuel to climb (including run up and taxi) and fuel to descend to cruise fuel.
- 2) Multiply this value by 6 lbs/gal, for total fuel weight used for flight.

The following total fuel calculation is used for the flight planning example.

1. Total fuel required (2.8 climb + 21.2 cruise + 1.0 descent)	25.0 gal
2. Total weight of fuel used for the flight	150.0 lbs

### **Flight Planning Considerations**

#### **Contaminated Runway Environment**

A contaminated runway can occur in any climate, and pilots must understand the potential effects on aircraft performance. Information provided below is referenced from AC 91-79 Runway Overrun Prevention (11/6/2007).

#### Standing Water

Standing water is usually the result of heavy rainfall and/or insufficient drainage. A runway is considered contaminated by standing water when >25% of the runway surface area (whether in isolated areas or not), within the required length and width being used, is covered by 1/8 inch or more of standing water.

#### Slush

Slush is water-saturated snow that displaces with a splatter when pressed upon. It is normally encountered at temperatures above freezing and at or below 5°C (41°F). A runway is considered

contaminated with slush when >25% of the runway surface area (whether in isolated areas or not), within the required length and width being used, is covered by 1/8 inch or more of slush.

Wet Snow

Wet snow sticks together easily and forms a snowball if compacted by hand. A runway is considered contaminated when >25% of the runway surface area (in isolated areas or not), within the required length and width being used, is covered by 1/4 inch or more of wet snow.

Dry Snow

Dry light snow is loose and can easily be blown. If compacted by hand, it will readily fall apart. A runway is considered to be contaminated with dry snow when more than 25% of the runway surface area (whether in isolated areas or not), within the required length and width being used, is covered by the equivalent of more than 1/8 inch of dry snow.

**CAUTION**

*Performance charts do not factor effects of contaminated runways or precipitation drag. Flight crews must carefully evaluate any expected impact on aircraft performance.*