Short-Field Approach and Landing

Objective	
To ensure the applicant learns the purpose of and can exhibit a clear understanding of short-field landing maneuver and how to perform the maneuver properly.	
Purpose	
Short-field landing technique is naturally used for landing on short runways, however it also emphasizes precision airspeed control and develops spot landing techniques. Pilots who master short field landings will greatly improve their normal landing techniques.	

Schedule	**Equipment**

• **Ground Lesson**: 30 minutes
• Initial
  ▪ **Flight 1**: 40 minutes - *Introduction to Maneuver*
  ▪ **Flight 2**: 50 minutes - *Improve Proficiency (Dual)*
• Solo
  ▪ **Flight 3**: 30 minutes - *Improve Proficiency*
• Pre-Checkride
  ▪ **Flight 4**: 20 minutes - *Demonstrate Proficiency*
• **Debrief**: 10 minutes (*per flight*)
	• Airplane POH and Checklist
	• Whiteboard / Markers (optional)
	• Model Airplane (optional)

Student Actions	**Instructor Actions**
• Ask any questions, receive study material for the next lesson. • Watch linked video. • Review listed references.	• Deliver the ground lesson (below). • Demonstrate the maneuver in flight. • Debrief after each flight.

Completion Standards

- **Ground**: Student can explain the purpose of the maneuver and how to execute it properly.
  - Can explain short field obstacle clearance procedures, flying behind the power curve, calculating landing performance, and the dangers of floating.
- **Flight**: Student can perform the maneuver to the applicable ACS standards.
  - Performs a stabilized approach at published short-field approach airspeed (or 1.3 Vso) +10/-5 knots.
  - Touches down safely at a designated touchdown point -0/+200 feet (*-0/+100 feet for Commercial*).
  - Applies positive braking.
  - See expanded Completion Standards below.

References

- ERAUSpecialVFR - “Short Field Approach & Landing”
  - YouTube - https://www.youtube.com/watch?v=zz6gvSmz5DM
- MzeroA Flight Training - “Short Field Takeoff and Landing”
  - YouTube - https://www.youtube.com/watch?v=A7dcr12EqwE
- FAA-H-8083-3C (Airplane Flying Handbook) - Chapter 9, Page 20-23 [Short-Field Approach and Landing], Chapter 9, Page 30-37 [Faulty Approaches and Landings]
- FAA-H-8083-25C (Pilot’s Handbook of Aeronautical Knowledge) - Chapter 11, Page 16-18 [Landing Performance], Chapter 11, Page 19-28 [Performance Charts]
- FAA Advisory Circular AC 91-79A (Mitigating Risks of Runway Overruns) - Page 10-16
- FAA-S-ACS-6C (Private Pilot ACS) - Area IV Task F
- FAA-S-ACS-7B (Commercial Pilot ACS) - Area IV Task F
- FAA-S-ACS-25 (CFI ACS) - Area VII Task F

Ground Lesson Outline

- What are Short Field approaches?
  - Spot landings, in real short fields there is less margin for error
- Obstacles
  - The role of flaps and descent angle, Mechanical Turbulence
- Airspeed Control and Trim - 10% increase in speed = 21% increase in landing distance
  - Dangers of Excess Speed or Floating
- Behind the Power Curve - Energy Management
- Importance of a Stabilized Approach
- Estimating Glide Path - VGSIs / VASI / PAPI
- Choosing a Touchdown Point
  - Aiming point vs. touchdown point
- Landing Performance
  - Weight, Wind, Braking Action, Up/Down Slope, Density Altitude
  - Calculating landing performance data - But can you also take off again?
- Runway Width Illusion
  - Overshooting Crosswind Base-Final Stall/Spin Danger
- Safety considerations
  - Use of checklists, Visual traffic scanning, Awareness of obstacles
  - Runway incursion avoidance, Be prepared to go around
  - Windshear, Tailwinds, Wake Turbulence, Runway surface conditions
- Maneuver Description - step-by-step
- Expanded Completion Standards

Common Errors

- Improper use of landing performance data and limitations.
- Failure to establish approach and landing configuration at appropriate time or in proper sequence.
- **Failure to establish and maintain a stabilized approach.**
- Improper procedure in use of power, wing flaps, and trim.
- **Inappropriate removal of hand from throttle.**
- Improper procedure during roundout and touchdown.
- **Excessive airspeed or floating.**
- **Poor directional control after touchdown.**
- Improper use of brakes.

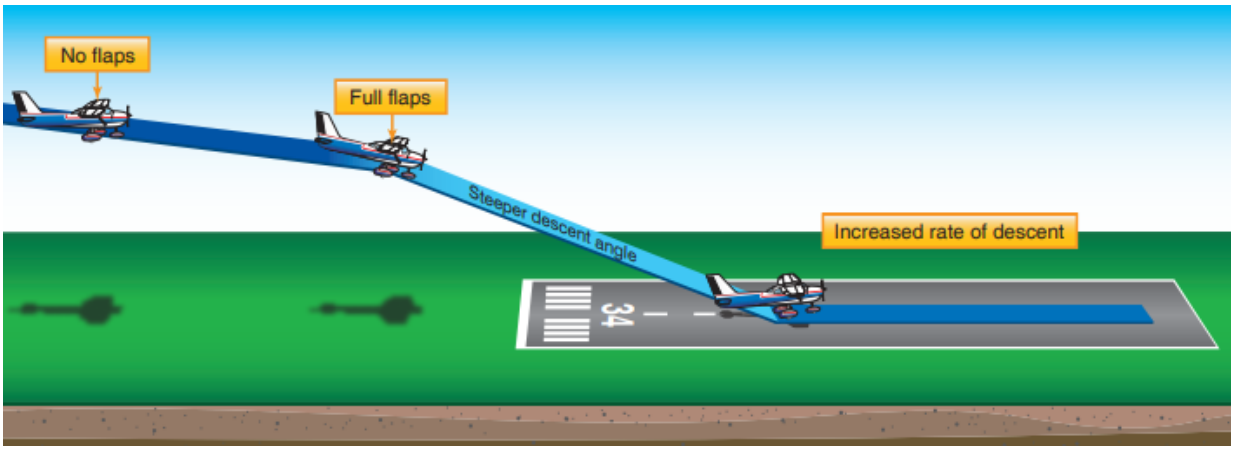
Ground Lesson Content

- **What are short field approaches?** - It may seem somewhat obvious from the name, but short-field approaches and landings of course involve techniques for landing on short runways (usually less than 2,500 feet), however short field technique can be used in a variety of situations.
    - Proper short field technique involves tight airspeed control and emphasizes spot landing skills
    - Creates awareness of obstructions on final approach and builds skills at flying steeper-than-usual final approaches.
    - Emphasizes the importance of a proper roundout and flare, with minimal floating, and the concept of having a designated point beyond which the pilot will initiate a go-around.
- Generally, landing on short fields means there is less margin for error. In the field below, the water is to either end of the runway and there is no runoff. There is no allowance for landing long!

- Additionally, these sorts of fields can present a quite intimidating sight picture when on short final! Despite this, with a proper understanding of short field techniques, pilots can determine if they can safely land on the runway and how to perform the approach safely.

- **Obstacles** - When conducting a short-field approach, clearing obstacles on final will often require a steeper than normal descent angle. *Flaps* are one tool for accomplishing this. Flaps add additional lift, but they also add additional **drag**. This will result in the airplane flying a *steeper descent angle* than it

otherwise would for the same approach airspeed. This has the additional benefit of allowing for better visibility over the nose when at very low airspeeds, as in a short-field landing.

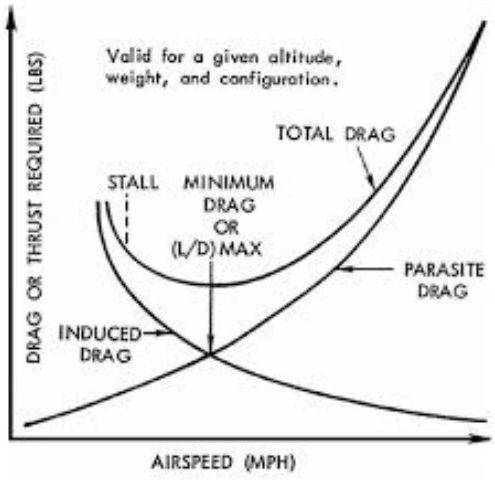


- **Airspeed Control and Trim** - When approaching to land, it is important to be aware of the proper short-field final approach airspeed. This will often be specified by the POH, but otherwise airspeed on final approach should be no higher than 1.3 x Vso, and in landing configuration (usually full flaps). **It is important to use the elevator trim to hold approach speed throughout the maneuver!**
    - **Dangers of Excess Speed and Floating** - According to the FAA's AC 91-79A, **"A 10 percent excess landing speed causes at least a 21 percent increase in landing distance"**. Being *on speed* is crucial to proper short-field landing performance. Even more dangerous is *floating* or delaying the touchdown. **Excessive floating on a short-field landing is unacceptable!** A good rule to follow is that if the airplane has not touched down within the first ⅓ of the runway surface, **go around**!

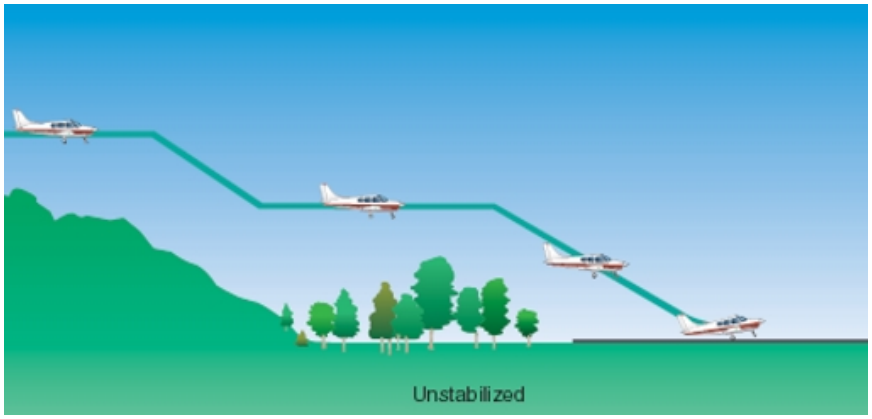
Condition	Effect on landing distance
Excess airspeed	
On dry runway	300 feet (90 meters) per 10 knots
On wet runway	500 feet (150 meters) per 10 knots
Extended flare (floating)	2500 feet (760 meters) per 10 knots
Delayed touchdown (at normal speed)	230 feet (70 meters) per second
Excessive height over threshold (at normal speed)	200 feet (60 meters) per 10 feet above normal over-threshold height

- **Behind the Power Curve** - When flying at approach airspeeds, particularly lower short-field approach airspeeds, it is important to remember that the airplane will be *behind the power curve*. The power curve represents the amount of power required to maintain a given airspeed without accelerating. This is at a minimum when the amount of total drag is at a minimum.
    - Airspeeds below the minimum drag speed (the best glide speed) are sometimes called the *region of reverse command*. This is because any increase in pitch, and therefore angle of attack, will result in more total drag, which will *increase* the rate of descent.
    - When behind the power curve, in order to control descent rate and glide path, the first action must be to increase or decrease the throttle! **Add or remove power to control the descent, and pitch to maintain airspeed.**

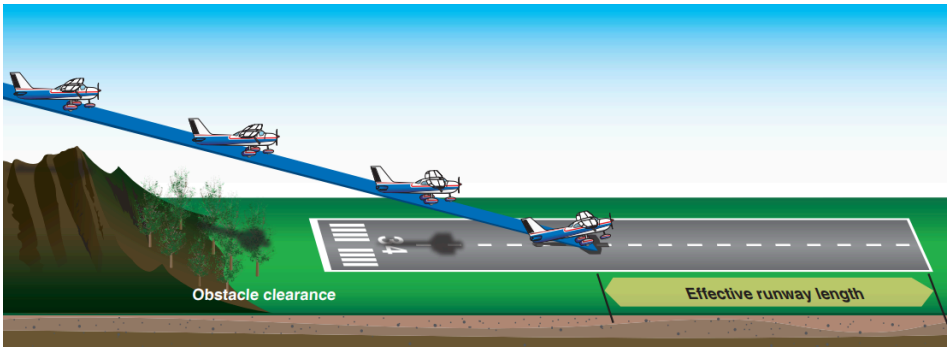
- It is useful to think about approaches in terms of **Energy Management**, where there is a fundamental difference between a *High Energy* and *Low Energy* approach, as these must be managed very differently.
  - See the lesson on *Area 10 (X) - Task B - Demonstration of Flight Characteristics at Various Configurations and Airspeeds* for more details on energy management.



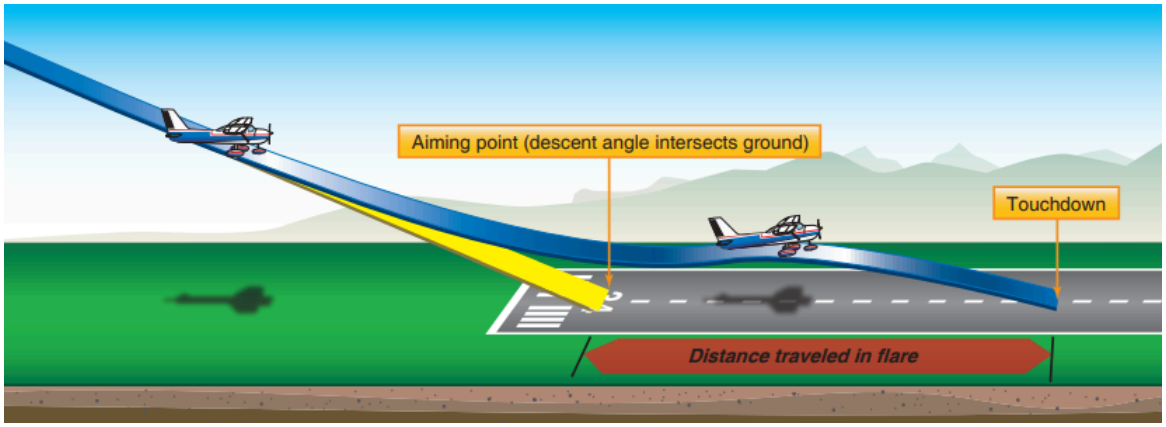
- **Importance of a Stabilized Approach** - As with all landings, the quality of the landing begins with the quality of the approach. It is critically important to maintain a *stabilized approach*.
  - **Unstable approaches are a leading cause of accidents and incidents during landing!**
  - The approach should involve smooth, gentle pattern turns, while maintaining the proper approach airspeed and avoiding dramatic forward slips or other maneuvers the entire time. It is important that the airplane be fully configured to land and flying at approach speed, and at a stable rate of descent, at least ½ mile before reaching the runway threshold. Generally, the approach should be stabilized before reaching 400ft AGL.



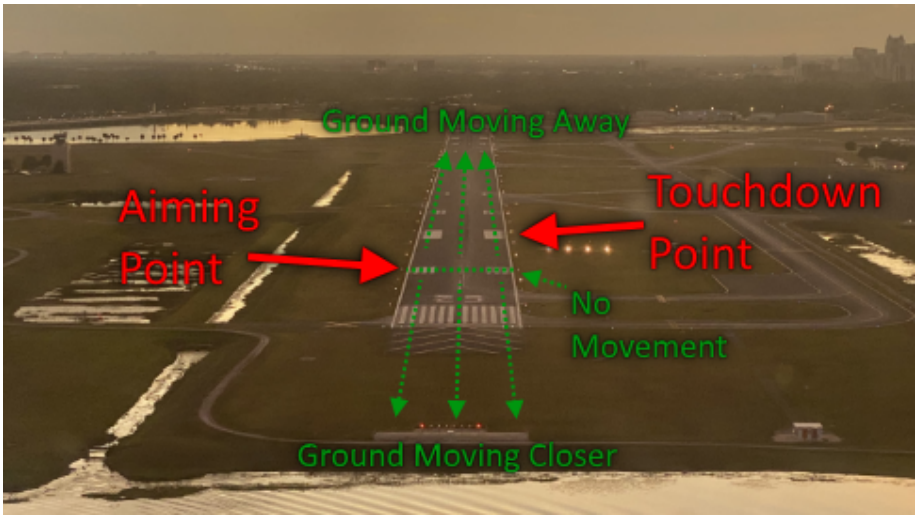
  - Even though obstacles on final approach, such as terrain or trees, may require a steeper descent, it is still preferable to fly a *stabilized approach* that will clear obstacles, rather than stepping down or otherwise flying an unstable approach. **Final approach should be flown in a *stable* descent, properly aligned with the runway or landing area!**



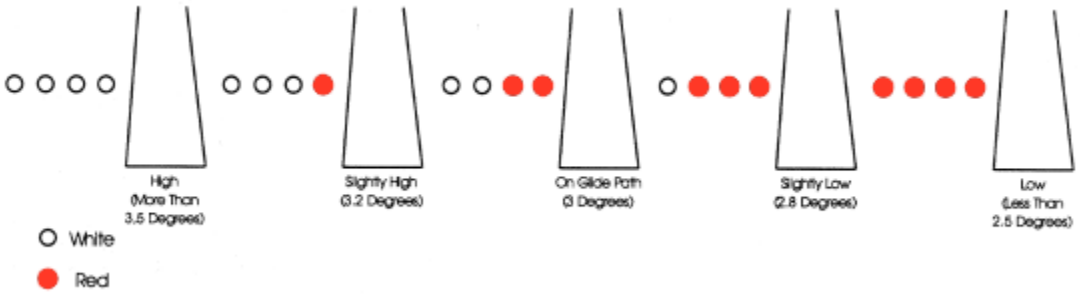
- As the airplane approaches the runway on final, the pilot should identify a point before the desired touchdown point and use it as an aiming point. As the airplane reaches the aiming point, a normal roundout and flare can be conducted, such that the airplane touches down at the touchdown point. **Aiming at the touchdown point would result in landing long**, because it does not account for the landing roundout and flare.



- **Estimating Glide Path** - In order to perform this maneuver successfully, pilots must develop their skills in visually estimating the airplane's glide path. This begins with finding an aiming point which is just before the desired touchdown point, to account for the roundout and flare. When in a stable descent, if the aim point is *moving away*, the landing will be short. When the aim point is *moving closer*, the landing will be too long. It is crucial to pay close attention to the movement of the aiming point and make the appropriate corrections.



- Some runways are equipped with Visual Glideslope Indicators (VGSIs), and when available they are a great tool for judging the glide path



- Pilots should conduct all landings to hit a designated spot, whether or not they are performing a high-performance landing. During the roundout and flare, the pilot should hold just enough back pressure to keep the airplane from touching down until the desired touchdown point is reached.
- **Choosing a Touchdown Point** - This maneuver involves demonstrating precision control over the approach path such that the landing occurs with minimal floating. A touchdown point on the runway should be selected such that the airplane will land **at, but not before**, this point, or within 200 feet beyond it. (For Commercial Pilot applicants, the standard is *100 feet*)
    - On a runway with precision markings, the 1,000 foot (aiming point) markers are a good choice, as on most runways they are 150 feet long. Other possible touchdown points can be a particular centerline stripe, or the numbers (for runways without other markings). *It is generally best to choose a marking that is not right at the start of the runway, to avoid the possibility of landing short of the runway.*

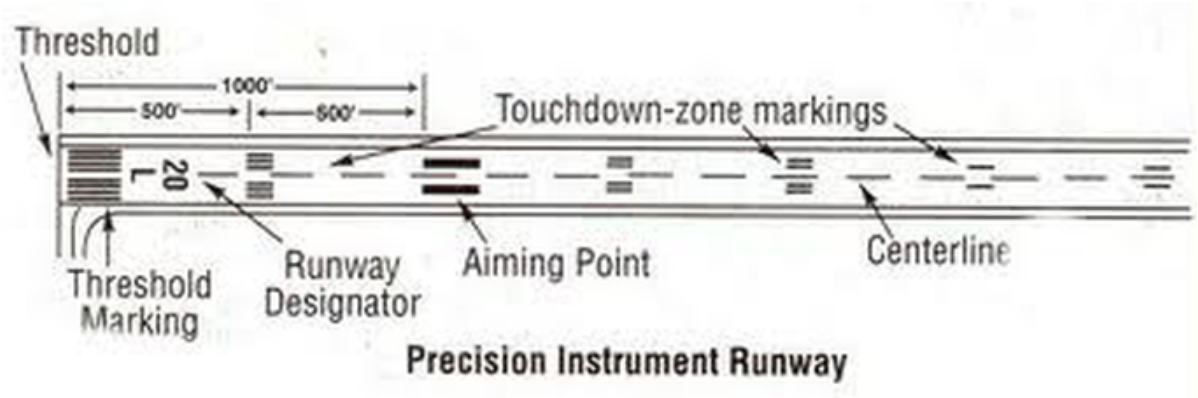
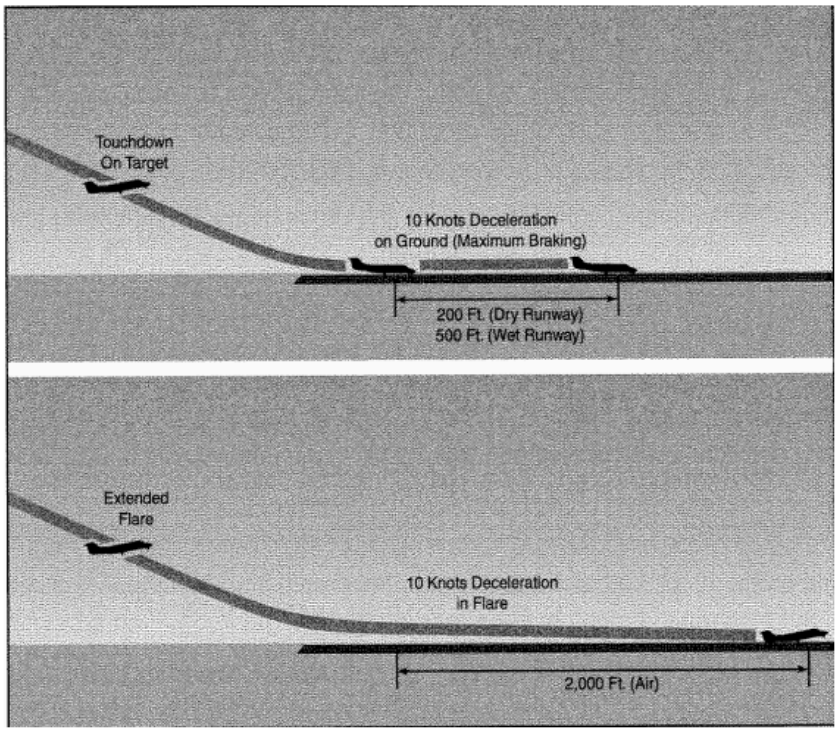


FIGURE 1-5. EFFECTS OF AN EXTENDED FLARE



- **Landing Performance** - Determining exactly how much distance will be required for the landing is crucial to ensure the chosen runway will be long enough to make the landing safely. An airplane's landing performance is highly dependent on several changing factors, such as **weight, wind, runway slope, braking action, and density altitude.** Aircraft performance at heavier weights or higher altitudes is greatly reduced.
    - *Density altitude,* which is a correction for atmospheric conditions, is the altitude that an airplane 'feels'.
    - At higher altitudes or on hot days, the density of the air will be less and therefore the airplane will need to move more air to stay aloft. Because the airspeed indicator is also affected by density altitude, it will show the same values, however the true airspeed will be higher.
    - **The difference between field altitude and the density altitude can be significant!**
        - See the related lesson on Density Altitude.
- The POH for every aircraft will contain performance charts that detail how many feet of landing distance is required for various weights, winds, and weather conditions. It also prescribes an airplane configuration that should be used.
    - To use the performance charts, first find the *pressure altitude*, by setting the altimeter to 29.92" or using the conversion. Then, find the cell in the table that matches the airplane gross weight with the pressure altitude and the current temperature. **Make sure to read the notes, in case distances need to be adjusted for wind or other conditions!**
    - It is best to add a 'safety factor' to the performance figures obtained from the POH performance charts. Generally, it is a good idea to overestimate the pressure altitude and temperature for a worst case scenario, and add 20-30% to account for the possibility of floating, however as noted above, **floating must be avoided on high-performance landings!**

- **Don't forget to consider wind!** A tailwind dramatically increases takeoff and landing distances. Likewise, a strong headwind can greatly improve performance.

LANDING DISTANCE

SHORT FIELD

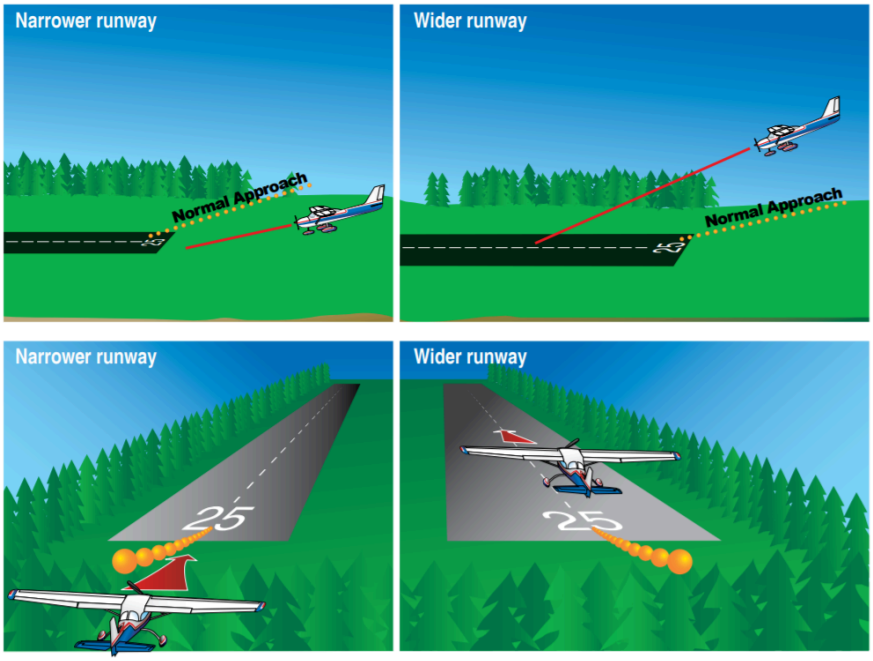
CONDITIONS:
Flaps 30°
Power Off
Maximum Braking
Paved, Level, Dry Runway
Zero Wind

NOTES:
1. Short field technique as specified in Section 4.
2. Decrease distances 10% for each 9 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2 knots.
3. For operation on a dry, grass runway, increase distances by 45% of the "ground roll" figure.

WEIGHT LBS	SPEED AT 50 FT KIAS	PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
			GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
1670	54	S.L.	450	1160	465	1185	485	1215	500	1240	515	1265
		1000	465	1185	485	1215	500	1240	520	1270	535	1295
		2000	485	1215	500	1240	520	1270	535	1300	555	1330
		3000	500	1240	520	1275	540	1305	560	1335	575	1360
		4000	520	1275	540	1305	560	1335	580	1370	600	1400
		5000	540	1305	560	1335	580	1370	600	1400	620	1435
		6000	560	1340	580	1370	605	1410	625	1440	645	1475
		7000	585	1375	605	1410	625	1440	650	1480	670	1515
		8000	605	1410	630	1450	650	1480	675	1520	695	1555

Figure 5-10. Landing Distance

- **Runway Width Illusion** - A narrower-than-usual runway can create certain visual illusions that induce pilots to fly a much closer-than-normal downwind and base leg (the runway appears further away), which in turn creates an unstable approach or overshooting final.

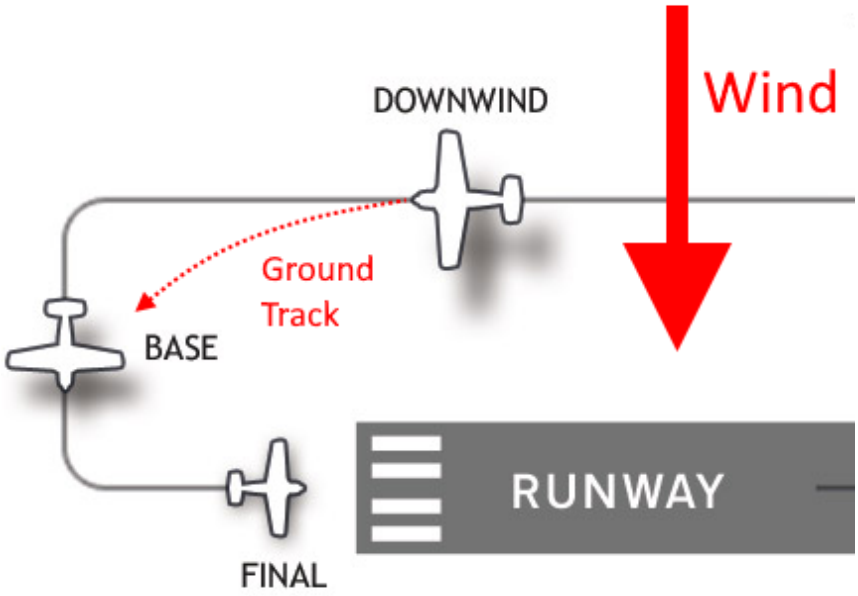


Runway width illusion

- **A narrower-than-usual runway can create an illusion that the aircraft is higher than it actually is, leading to a lower approach.**
- **A wider-than-usual runway can create an illusion that the aircraft is lower than it actually is, leading to a higher approach.**

- **Overshooting Crosswind and Base-to-Final Stall/Spin Danger** - When a pilot flies an excessively close downwind, there is a high probability of overshooting the turn to final. Many pilots then fall victim to the trap of trying to tighten the turn with uncoordinated use of rudder or

increasing the load factor, leading to a stall and spin. This is particularly common when there is an *overshooting crosswind*, where the crosswind is coming from the direction of the downwind leg. When pilots do not apply proper crosswind corrections on downwind, the downwind leg gradually gets closer to the runway, increasing the chances of an overshoot.



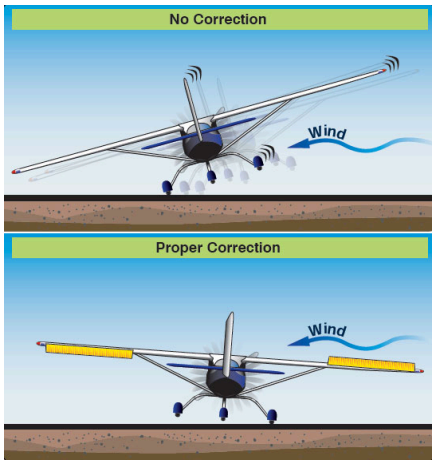
- **Safety Considerations**
  - As with any landing, the **use of checklists is important**. Before beginning the maneuver, the before landing checklist must be completed. After landing and rolling out to a safe point clear of the runway, the after landing checklist should be completed.
  - **Short-field landings often occur in confined areas and require extra caution for powerlines, tall trees, or other obstacles which may be quite near the runway environment.**
  - It is crucial to not become so focused on the maneuver that an unsafe situation is created. Maintain situational awareness, make appropriate radio calls, and ensure that landing clearance is obtained before landing. **Vigilance must be maintained after landing to avoid taxiing onto any intersecting runways beyond other hold short lines.** If there is a control tower, do not forget to contact ground control for taxi clearance after landing, and at uncontrolled fields, clearly communicate your taxi intentions on the radio. Remember that uncontrolled fields often have no-radio (NORDO) pattern traffic, so **always visually verify the runway and final approach path is clear!**
  - Maneuvering in the pattern at low airspeed creates a risk of a stalling situation. If the stall warning sounds before the landing flare, go around!
  - When executing any landing, there should be a point identified (*no further than the first 1/3 of the runway*) beyond which if the airplane has not touched down you will go around. **Always be prepared to go around!**
  - **Windshear, Tailwinds, Wake Turbulence** - During takeoffs and landings, we are operating near the ground at low speed. Pilots should exercise caution if there are indications of windshear, pay attention to situations where wake turbulence will be a factor. Additionally,

taking off or landing with a tailwind creates a much higher ground speed, lengthening the ground roll, and increasing the danger.

- **Runway Surface Conditions** - If the runway is wet or icy, it can be quite slippery, particularly in the touchdown zone where many preceding aircraft have deposited rubber. Exercise caution in these situations!

Maneuver Description

- **Selecting a Suitable Runway** - Select a runway that will allow landing into the wind, or with a manageable crosswind.
- **Selecting a Touchdown Point** - Select a prominent feature on the runway that is easy to identify from the downwind leg, and explicitly state it. Features like 1,000 foot markers, touchdown zone markers, or runway numbers are good choices. Until proficiency is developed, select a feature that is not directly at the start of the runway, in case of landing short.
- **Entry Position and Altitude** - The maneuver should be entered on a normal downwind leg, abeam the touchdown point, at normal pattern altitude.
- **Entry Airspeed** - The maneuver must be started at less than **Va** (maneuvering speed). Choose a normal level cruise flight airspeed and power setting, at least 5-10 knots below Va. Ideally, begin this maneuver at a normal traffic pattern airspeed.
- **Checklists** - Pilots must perform a before-landing checklist before beginning the maneuver, and an after-landing checklist after taxiing safely clear of the runway, for full-stop landings.
- **Airspeed** - Airspeed should be kept at the short field landing airspeed designated by the POH, or slightly higher (add half the gust factor) to account for gusting wind conditions. *Be vigilant about maintaining airspeed, and if the stall indication is heard at any point before the final landing flare, discontinue the maneuver and go around!*
- **Bank** - Since this maneuver takes place in an airport traffic pattern and involves maneuvering at low speed and at low altitude, the bank angle should be *less than* **30 degrees**.
- **Approach Path** - Fly a normal, well-defined base leg and final approach segment. Avoid cutting the corners or overflying the final approach course.
- **Coordination** - The maneuver should be flown in coordinated flight. Attention should be given to proper rudder input during turns.
- **Touchdown** - Choose an aiming point such that the airplane will land *at, but not before*, the selected touchdown point, or within 200 feet beyond. (*100* feet beyond for Commercial Pilot applicants) The landing should be at a proper pitch angle (*not on the nosewheel-- do not force it!*), safe, and under control. Positive aircraft control must be maintained at all times! **Apply *and hold* proper crosswind corrections to avoid sidewards drifting.**



- **After Touchdown** - Apply aerodynamic and wheel braking as specified by the POH. (You may be permitted to simulate hard braking if not flying on an actual short field, but plan to apply more than normal braking.)
- **Be Prepared to Go Around!** The approach may not work out and a go-around is very possible. Be prepared to execute a go-around if needed.

- **This is a visual maneuver!** Eyes should remain outside the cockpit as much as possible to scan for traffic and ensure proper management of the approach path. *Monitoring for other traffic is especially critical when performing this maneuver at uncontrolled airfields.*

Expanded Completion Standards

- The pilot can explain the purpose of the short-field landing maneuver and how wind and other factors affect the performance of the maneuver.
- The pilot can perform the maneuver to the following standards:
    - Pilot selects a runway suitable for the weather conditions, establishes the airplane on a downwind leg at pattern altitude, performs a pre-landing checklist, establishes a speed *below* **Va**, makes the appropriate radio calls, and designates a touchdown point.
    - At the normal abeam point on the downwind, the pilot closes the throttle, applies carb heat as necessary, and establishes a descent at the short-field approach airspeed (or 1.3 Vso) +10/-5 knots.
    - Pilot manages the descent and aims for a point so as to make a safe, controlled landing **at or within 200 feet beyond** (within 100 feet for Commercial) **the designated touchdown point**. (The pilot may not touch down before the designated point)
    - Pilot applies wheel and aerodynamic braking techniques.
    - Pilot divides attention between accurate, *coordinated airplane control* and outside visual references.
    - Pilot performs a timely go-around if the safe completion of the maneuver *within standards* is in doubt.