Chapter 10

The Roundout and Flare
You Have the Nod to Hit the Sod

What goes up must come down
Spinnin’ wheel got to go ‘round

“Spinning Wheel”
Blood, Sweat and Tears

Are you ready for The Question? Brain engaged? Pampers positioned? As you approach the runway, how and when do you transition from a steeper descent into a shallower one that eventually results in the airplane’s main wheels touching down softly on the runway?

This is an important question that every pilot must answer if he or she is to land an airplane. Since we’ve already agreed that you want to land, let’s begin with a thought experiment.

Suppose you maintained the descent rate you had on final approach (approximately 500 to 600 feet per minute) and did nothing else but fly the airplane right onto the runway. Can you see it? Did you land? Hardly. Which is exactly the way you would land. Hardly.

You most likely approached at a nose down angle, and got nose hosed when the airplane’s nose wheel contacted the runway before the main gear as shown in Figure 1. That can result in a broken...
nose gear and even a bent propeller. Bad gear, bad prop, bad day. This is why tricycle-geared airplanes sometimes come back to the FBO as bicycle-geared or sometimes shear-geared.

If you managed (in your mind) to contact the runway at a slightly less nose-down angle (but on the nose gear, nevertheless), you probably performed the aviation version of the ricochet. You hit the runway, then bounce back into the air, performing a maneuver that’s best left in a Roadrunner cartoon. These types of bounces can lead to low altitude stalls or an impact that damages the landing gear, the propeller, your passengers’ confidence in you, your dignity, and more. Beep! Beep! No thanks.

Avoiding ricochets, beep-beeps from your stall horn and squeak-squeaks from your passengers during landing requires knowing how to round out the landing approach (transition from a steep to a shallower descent rate) and flare the airplane onto the runway (allow the airplane’s main gear to settle onto the runway when the airspeed has decreased to just above stall speed). These are the two steps necessary to land on your main gear, under control, while maintaining a constant state of landing happiness. It’s a ballistic ballet that’s a feat without feet. That’s what we’ll learn to do in this chapter. Let’s begin with the roundout.

The Roundout

As you recall, at the end of the last chapter, I didn’t let you down. Well, I mean I didn’t talk you all the way down to the runway, leaving you a bit up in the air. My apologies, but I intend to make it up to you, because we are now going to get down!

Final approach has gotten you this far, which is good, but in order to land nicely you now need a different approach. This is where you’ll begin the first part of the landing maneuver known as the roundout (Figure 2, position A).

The roundout begins with you, the pilot in command, reducing power (if any is still being applied) to flight idle while simultaneously applying sufficient elevator back pressure to break the glide and transition to a shallower descent angle. OK, you’re not actually breaking anything, so if you’re a Demolition Derby king or queen, don’t get all excited and giggly. Your objective is to raise the nose so that the longitudinal axis of the plane is initially parallel with the runway.

The Roundout, Flare and Touchdown

A safe and successful landing requires transitioning from the approach descent by raising the nose to a level flight attitude (A-the roundout), slowing the airplane down (B-the flare), followed by touching down on the main wheels (C-the touchdown).
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The immediate result of this action is that your airspeed begins to decrease. As you continue pulling aft on the elevator control, the airplane should continue to settle toward the runway at a very low descent rate of perhaps 100 to 200 feet per minute. It’s the reduced descent rate caused by the roundout that provides you with time to assess your closure rate with the runway. You’re seeking a cue for the next act, which is the flare, for which you will develop a flare, I’m sure.

Because you’re approaching at 30% above stall speed, you have just enough kinetic (airspeed) energy to control your closure rate with the runway during this maneuver. Yes, you’re eating into a limited airspeed allotment, but that’s OK. The goal is to land slightly above stall speed.

Oh look, there’s the runway about a foot away. Now that you’re there, it’s time to flare.

The Flare

The landing flare follows the roundout, and technically begins the moment the airplane’s nose rises above a level flight attitude with the continued application of elevator back pressure. In other words, the nose gear rises above the main gear during the landing flare as the angle of attack increases and the airplane continues to decelerate (Figure 2, position B). The landing flare accomplishes two very important things. First, it allows the airplane’s initial contact with the runway to be on the main gear, thus protecting the more fragile nose gear from damage (Figure 2, position C). Second, it allows the airplane’s speed to continue decreasing to just above stall speed, meaning the airplane becomes less and less likely to continue flying once the wheels make contact with the runway (also known as the touchdown).

From the position of an observer standing alongside the runway, the landing flare appears to be your attempt to keep the main gear from touching the runway, at least until the airplane finally has insufficient speed to remain airborne. Psychologically speaking, this is how you should conceptualize the landing flare. After the initial approach path is rounded out and made shallower, you’ll let the airplane gently settle from a height of 12 inches or less onto the runway surface. This is how the landing flare is accomplished in a tricycle geared airplane.

Now that you know of the two components associated with landing, we’ll discuss both in more detail. Our objective is to answer two questions. When do you begin the roundout? How fast do you flare for landing?

Why Ground Shy?

One of the very interesting phenomena to observe when introducing students to landings is how they almost instinctively introduce students to landings is how they almost instinctively
pull aft on the elevator as the runway comes closer. I’ve even seen this behavior in students while descending toward a solid, flat stratus layer of clouds during an instrument approach. The student automatically reacts by pulling back at the sight of what appears to be a solid surface.

This reflex is nearly as natural to a five-hour student as putting your hands out to break a fall. This shouldn’t really be a surprise to anyone, since riding 2,000 pounds of sheet metal on a trajectory toward a solid surface (the runway) or one that appears solid (a flat cloud deck) does stir certain primal survival instincts. As far as your brain knows, nothing good can come of the impending impact.

Unfortunately, this can lead to what might best be called air flare. The pulling aft action is often begun at 20-40 feet above the runway, which is about 19-39 feet too high. Worse, students are not even aware that they are doing it. The problem with the aft pull at too high an altitude is that the airplane often doesn’t have enough energy (think airspeed here) to do a proper roundout and flare, resulting in a rough or dangerous landing.

The antidote to this problem is brain drain. You have to drain your brain of the train of thought that it’s on and get on a different track by recognizing that the air flare phenomenon exists, and then train your brain to think differently.

It’s your flight instructor’s job to point it out when he or she sees you pulling aft prematurely on the elevator. For instance, you might hear your instructor say, “Don’t do that,” in reference to a premature pull on the elevator. This, and a hand gently placed on the elevator to prevent you from pulling it aft prematurely should help form a new and move favorable behavior pattern. Then again, most students get the idea once it’s pointed out them.

**When Do You Begin the Roundout?**

It is beyond a doubt time to round out. You begin rounding out the airplane for landing when you’re 10 feet above the runway (Figure 3). Believe it or not, several million years of evolution have equipped you with a very functional 10 foot height detector.

That’s right, pilot, you come equipped with the necessary skill built in. (See: *The Runway Expansion Effect* on Page 10-6.)

One of our two basic, instinctual fears is the fear of falling. Even a very young infant will shy away from a perceived edge of a precipice. We’re pretty good at estimating the height from which a fall could really hurt; those who couldn’t do so were summarily dismissed from the gene pool a long time ago. It’s not surprising that most of us who have survived can, just by looking, make a reasonable guess as to what a dangerous height is.

When it comes to landing, however, you can’t look straight down at the ground out your left window because the ground will appear blurry and thus offer little or no surface details with which to gauge your height. At a typ-
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Sensory-Rich Runway Environments

The more sensory-rich the runway environment, the easier it will be to properly gauge the height for roundout. But every place isn’t Hollywood or New York, so sometimes the airports you’re landing at are just plain plain, which is a pain. No bells, no belles, no whistles, no thistles. The runway has few markings (or they’ve faded over time) and few surface clues (the rabbits ate all the bushes and the locals ate the rabbits, leaving the pilots to stew). It’s possible to compensate for this problem to some degree by having the tower activate the runway edge lighting (or activating it manually to its highest setting if there is pilot controlled lighting). Because we see lighted objects better peripherally, this has helped some students to better gauge when to begin the roundout for landing (lights are not always available during the day, unfortunately). Additionally, make sure you aren’t wearing polarized sun glasses during landing practice, which can reduce your visual input, especially in terms of the detail associated with the runway environment.

As you begin your roundout by looking at a point on the runway 50 to 80 feet ahead of you, your ability to gauge your height above the landing surface is aided by a (hopefully) rich runway environment. ”Rich” in this context doesn’t mean you’ll see stacks of stocks and bonds. It means a runway foreground that contains shrubbery, runway lights, VASI light boxes, a windsock and runway markings and other runway accessories that are to a pilot what Louboutins are to a fashionista. These visual clues (except the Louboutins) aid you in estimating your height above the ground. What a feat.

A 2006 study conducted by the Australian Transportation Safety Board found that a rich runway foreground improves a student’s ability to more accurately time the landing flare (estimate his or her height above the ground). Remove all these visual clues and you create an environment similar to landing a ski plane on a featureless bed of snow or a floatplane on glassy water. Anyone who has tried landing on this type of surface knows that judging height above that surface is extremely difficult. This is why floatplane pilots are taught to establish a very shallow descent all the way to touchdown when landing on a mirrored water surface (hopefully they won’t be glancing at that mirror and fussing with their hair while saying “Oh yeah, who’s your daddy?” just as they’re ready to touch down). Flaring isn’t necessary during these types of landings because the airplane is at a very slow speed in a slight nose high attitude and is literally flown onto the snow or water.

Where to Look When Beginning the Roundout for Landing

From the Cockpit
There is one very important but little recognized clue that tells you precisely when to begin the roundout for landing. I call it the Runway Expansion Effect. Here’s how it works.

As you approach the runway during a stabilized approach at 1.3 Vs, the runway’s trapezoidal shape appears to grow in your windshield. For instance, the outlines of the runway shown on the next page are presented in Picture-1 from a period between 18 seconds prior to touchdown to eight seconds prior to touchdown. It’s clear from these outlines that during a stabilized approach to a desired landing spot somewhere in the first third of the runway, the runway’s size appears to increase while its trapezoidal shape remains relatively the same. On the other hand the rate at which the runway grows (expands) in your windshield isn’t linear.

Looking at the width of the runway threshold as a measure of its size, you can see in Picture-1 that from 12 seconds to 10 seconds prior to touchdown, the runway threshold width appears to expand approximately four times as you observe it from the cockpit. From 12 to eight seconds prior to touchdown, the runway threshold width appears to expand 10 times in your windshield (this includes what you see with your peripheral vision, too).

This expansion isn’t a linear at all. In fact, it’s more of a geometric expansion as shown by Picture-2. This figure graphs your perception of the runway’s width (as you observe it from the cockpit starting at 18 seconds from touchdown) and compares its growth all the way to touchdown in two-second intervals. During the period from 12 to eight seconds prior to touchdown, the runway appears to increase in size 10 times (Picture-1). The most rapid period of growth in any two second interval occurs from 12 to 10 seconds prior to touchdown (Picture-2). The 10 second cue is the point where the runway expansion can be used to alert you to begin the roundout for landing.

While flying a stabilized approach to the desired landing spot on the runway, the moment you notice a sudden increase in runway width, you should raise the nose and place the airplane’s longitudinal axis level with the runway. Congratulations, you’ve just performed the roundout and are now approximately 10 feet above the runway. Believe me when I say that you will notice the runway expansion effect. In fact, it’s because of the sudden runway expansion that pilots often become spooked at a point approximately 10 seconds prior to touchdown and overflare their airplane as a result. The secret here is in knowing about this effect then looking for it as a cue to begin the roundout. Of course, how fast you roundout is important, too. You don’t want to roundout so slow or so quickly so as to either hit the runway or flare too high, respectively. Looking at the landing sequence on the opposite page, it’s clear that the roundout takes place in a little less than two seconds, which is about right for most small airplanes.

If you don’t have excessive airspeed during the roundout, then you can easily transition directly into the landing flare by raising the nose just a bit more and placing the top left-hand side of the cowling on the horizon and keeping it there until the airplane touches down (excess airspeed means you must transition to the flare much more slowly). The flare sequence is shown beginning at four seconds prior to touchdown on the next page. This raises the nose gear high enough to allow the main gear to touch down first.

While this is a rather mechanical method of performing the roundout and flare, it does use the same visual cues that experienced pilots use when landing, especially when landing at night. It is, however, independent of any other visual cues you might have learned to help assess your height above the runway. Nevertheless, used in conjunction with your previously learned visual landing cues, you’ve got a powerful method to assist you in determining when to begin the roundout for landing.
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10 Seconds Prior to Touchdown
12 Seconds Prior to Touchdown
14 Seconds Prior to Touchdown
16 Seconds Prior to Touchdown
18 Seconds Prior to Touchdown

8 Seconds Prior to Touchdown
6 Seconds Prior to Touchdown
4 Seconds Prior to Touchdown
2 Seconds Prior to Touchdown

Roundout here
Flare begun here
More flare
Runway expansion effect seen here

Aft elevator applied to keep cowling on horizon
Aft elevator applied to place cowling on horizon
Aft elevator applied to keep cowling on horizon
Unfortunately, it’s very difficult to fly an airplane onto a runway in a similar manner. Lakes and snowfields tend to be really long, runways much less so. That’s why it’s necessary to learn how to flare the airplane for landing.

Identifying a height of 10-15 feet above the runway is relatively easy for most student pilots, especially when they have a chance to see what this height looks like from the seated position inside the cockpit.

What most pilots aren’t accustomed to is having the runway ahead of them disappear from their sight as they raise the nose during the roundout and subsequent landing flare (Figures 5, 6 and 7). Say again. That’s right! The runway can disappear from sight as the nose comes up and blocks the pilot’s view of the landing surface, which isn’t a pretty sight from the cockpit (mainly because there’s no sight to see). Before we can examine the details of the landing flare, we need to solve the case of the missing runway.

The Case of the Missing Runway

Here’s how your runway can become a runaway during the roundout and subsequent landing flare.

As you pull aft on the elevator to perform the roundout, the nose comes up and the cowling goes with it (this is, generally speaking, good). Continuing to pull aft on the elevator for the landing flare raises the cowling above the horizon, which is where the vision thing becomes a problem. You can’t see through the cowling (well, most of us can’t, but most of us aren’t affected by Kryptonite, either), so the runway directly ahead of you suddenly disappears from sight. Gone, but not forgotten. How nice is that? The thing you were using to gauge your height above the runway—the runway ahead of you—now disappears from your view. Only a mad scientist or a normal flight instructor could think up a worse way to torment a student in flight training.

You’ve got to sit high in the saddle, pardner. An important element in keeping the runway in sight involves sitting high enough in the seat so that you have the best chance of seeing the touchdown area for as long as possible during the roundout and subsequent landing flare. Trust me when I say that most students seldom—yes, I said it, “seldom”—sit high enough in the seat to assist them in seeing what’s ahead of their flying machine. So, I’ll give you the lowdown on sitting high. And I don’t want you to take this lying down.

Sitting Height

It turns out that your mother and teachers were right. You need to sit up straight, despite the fact that you graduated from the Quasimodo posture school with honors.
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In high or low wing airplanes, you should be sitting high enough so that your eyes are just below the top of the left window frame (Figure 8). This allows you to see aircraft out your left window without having to bend your head forward like a giraffe that suddenly decided to try grazing grass (or a high school student texting). It also gives you the best shot at seeing over the panel. Sitting as close as feasible to the panel also helps, since this lets you peer down at the runway at a steeper viewing angle (Figure 9).

This isn’t a circus act, and I’m not trying to make you into a contortionist. I don’t want your legs cramped and the elevator control touching your belly. Sit close enough to the panel so you can apply full rudder travel using the balls of your feet. Of course, sitting too far aft will make it difficult to see the runway over the panel (Figure 10). So find a good horizontal and vertical seating position and remember it.

Do whatever it takes to get into this position. Ironically, women are better at doing this than men. Women know they are shorter (on average) and they aren’t afraid to add a cushion here or there. It’s men who are too often cushioning their egos instead of their butts. Ultimately, you may need to sit on cushions (Figure 11) and have a cushion behind you to move you forward in the seat (Figure 12). I don’t care how you do this or whose furniture you have to rob to make it happen. Just get those cushions and move on up. Take my word for the fact that if you can’t see the runway, this landing thing is going to be a whole lot more difficult.

No matter how well cushioned your landing, there comes a point where the rising cowling makes seeing the runway over the engine cowling during the roundout and flare impossible in most airplanes. That’s why you don’t want to look straight ahead over the nose during the landing flare when the nose is at flare attitude.

A good seat cushion often makes all the difference in terms of the ease with which you learn to land.
Instead, you want to shift your vision from looking straight ahead to looking slightly left of the engine cowling and focusing on a point to left side of the runway centerline that’s still visible to you (Figure 13). This means looking down and to the left slightly, at an angle of about 10 to 15 degrees. This directs your eyes to a spot on the runway 50 to 80 feet ahead of you. Based on your present speed, the runway at that spot appears neither blurry nor motionless, which we’ll call the sweet spot (Figure 14). In other words, you’re looking far enough ahead of the airplane to see a portion of the runway surface that’s sufficiently detailed that it allows you to continue to estimate your height above the ground. The far end of the runway as well as the distant horizon are also visible to the left side of your cowling, allowing you to use your normal and peripheral vision to help evaluate pitch attitude during the flare.

If you look straight down out your left window during landing, the runway will appear blurry to you. You simply can’t see the ground well enough to identify surface details, thus preventing you from estimating your height for the roundout, much less the flare. (See sidebar: Driving and Landing.)

If you look too far ahead, such as only looking at the distant horizon, you’ll lose your ability to perceive your rate of closure with the runway surface, which also prevents you from properly estimating your height above the ground. This is why you look at that portion of the runway—the sweet spot—ahead and to
your left, where the blurry motion stops yet the runway still appears to move. Now you have the depth perception necessary to gauge your height above the landing surface. See how I let you down by not letting you down with these important tips? Now it’s time to sweeten things up by taking a closer look at the sweet spot.

The Sweet Spot

The sweet spot for us is typically framed by the left side of the engine cowling, the right side of the window post (on those airplanes with window posts, of course), and the horizon. The frame takes the shape of a pizza slice through which you’re viewing a portion of the non-moving runway and the horizon (Figure 15). This is only available as takeout, by the way.

Looking anywhere besides in the pizza slice during the landing flare generally means you’re looking in all the wrong places and won’t know how high you are above the ground. And how much fun can that be when a large solid slab of solid runway is rising to meet you?

You should also be aware that the sweet spot ahead of you where the blurry motion stops will appear to move toward you (horizontally) as the airplane slows down during the landing flare (Figure 16). In other words, the sweet spot is approximately 50 to 80 feet ahead of you as you begin the roundout and flare, then it moves closer (think 40 feet, then 30 feet, then...you get the idea, right?) as your speed decreases.

Think about it for a second and you will see just how much sense this makes. When the airplane is stopped on the runway, you can look directly down out your left window and see a non-moving section of the runway with perfect clarity. How sweet is that? That’s why you have to continually shift your vision just a little closer toward the airplane during the landing flare to maintain visual contact with the sweet spot.
In addition to looking at this non-blurry sweet spot ahead and to the left, you are also using peripheral cues associated with the runway environment to help assess your height above the runway. Sure, there aren’t a lot of obvious vertical peripheral cues in this area such as buildings, huts and men holding large rulers vertically. But the white runway stripes, the runway lights, the grass, the rabbits and so on add dimensional perspective that helps you assess your height above the ground.

Now we’re ready to answer the question, “How fast should you flare for landing?”

**How Fast Do You Flare?**

The answer to this question is rather simple. *With power reduced to flight idle, you pull aft on the elevator to progressively raise the nose and reduce the airspeed while the airplane remains a foot or less above the ground.* Stating this, however, is much easier than doing it. So let’s examine this question in more detail.

During the roundout, as the airplane rotates through a level flight attitude you’ll transition directly into the landing flare by continuing with the aft pull on the elevator control. At this point, you’ll shift your attention from the runway directly ahead of you to the sweet spot located ahead and to the left of the cowling.

During the flare, if you pull the elevator control back too quickly the airplane will pitch up and climb because its airspeed is still above stall speed. That’s not good. Power is at flight idle, airspeed is slow and decreasing and right about now the stall warning horn is singing your song.

My friend, there is no silver lining in that dark cloud. The chance of stalling or settling hard onto the runway increases dramatically if you don’t release elevator back pressure to lower the nose and apply a little power to increase your airspeed (if it’s too slow) and decrease your descent rate (if it’s too high). If, on the other hand, you don’t pull back fast enough, there’s a good chance that you will hit the runway on the nose wheel or with all three wheels at the same time (which is not how you land a tricycle geared airplane).

It’s clear that the rate at which elevator back pressure is applied is a totally new experience if you’ve never landed an airplane before. After all, you’ve never had to calibrate changing the airplane’s trajectory with reference to a solid surface just below the airplane, have you?

Probably the only semi-similar experience you’ve had in the plane was leveling off at a specific altitude by reference to a tiny altimeter needle representing an altitude, which doesn’t offer the same resistance a runway would if you tried to fly through it. There is, after all, nothing physically solid about an altitude unless it represents the beginning of something physically solid. Ultimately, it will take you a few landings to get a feel for how much back pressure to apply to the elevator to prevent under- or over-flaring the airplane. But that doesn’t mean there aren’t a few exercises that might help you develop this skill.
The Ultimate Training Exercise for Learning the Landing Flare

Here’s a wonderful training exercise that you can do with a competent and capable flight instructor on board to help you calibrate your rearward pull on the elevator control during the flare.

Under your instructor’s supervision, approach the runway with no more than 10-15 degrees of flaps at a speed of 1.3 Vs. As the airplane reaches a height of 10-15 feet above the runway, simultaneously raise the nose and apply sufficient power to hold 10-15 feet of altitude at 1.3 Vs (Figure 17). Your objective is to track the runway centerline at approach speed while holding altitude. At first this will be quite challenging simply because you’ll have no idea what type of pitch response results from the pressure you apply to the elevator.

You may find yourself wandering all over the runway, mainly because you now have a chance to see how easy it is to over- or under-control the airplane when given a distinct reference by which to measure your deviation. What you learn from this example is the relationship between elevator movement and pitch change. It will only take a few trips down a reasonably long runway for you to calibrate your pitch inputs with airplane response. Once you get that idea into your noodle, you’re unlikely to over- or under-flare an airplane during landing practice.

This lesson is extremely useful because most pilots spend as much as 10 minutes flying one circuit around the pattern just to make one landing. Yet the part of the landing that pilots need the most exposure to is the part that’s a few inches above the ground and that lasts 10 seconds at most, otherwise known as the landing flare. So while you might make 10 landings in one training session, you only experience 100 seconds or less than two minutes in the environment where you learn how to flare.

Frankly, it’s amazing that anyone can actually learn to land as quickly as they often do with so little exposure to the landing flare. That’s why this training exercise is so valuable. It gives you much more exposure to the landing flare environment.

It’s also important to make sure that you begin your departure climb in sufficient time to avoid any obstacles at the end of the runway. You don’t want to turn a great training exercise into a hedge clipping debacle. That said, this is one of the most valuable training exercises you can do to further your feel for how to land an airplane. It’s also a wonderful exercise to help you learn about crosswind landings, too. We’ll chat more about that in the next chapter.
The Aft Elevator Pull and How It’s Not What It Seems

One of the peculiar things about moving the elevator aft during the landing flare is that it becomes less effective in raising the nose for a given amount of pull as the airspeed decreases. The slower you go, the more aft you must pull, as shown in Figure 18.

This provides you with the initially strange experience of having to pull aft on the elevator at an ever increasing rate as you try and maintain an ever decreasing descent rate during the landing flare descent. Of course, the amount of aft elevator movement applied varies between airplanes and even between the same airplane based on how it’s loaded, its trim condition, and so on. Nevertheless, it does take a few attempts at landing to “roughly” gauge the rate at which the elevator should be moved aft in the flare.

The important thing to identify here is that the aft elevator movement required to flare the airplane isn’t linear. Starting the roundout at 30% above stall speed, you’ll find that a little aft pull easily raises the nose and levels the airplane’s longitudinal axis with the runway. This is why it’s easy to overflare during the roundout but relatively less so during the actual landing flare. As the airplane decelerates because of the drag caused by the increased angle of attack, the aft elevator travel necessary to keep the nose coming up in the landing flare must increase noticeably (relatively speaking). When the main gear makes contact with the runway surface, the elevator is relatively far aft from its position at the beginning of the landing flare (Figure 19).

The amount of aft elevator travel shouldn’t come as a surprise. You already experienced something similar during slow flight practice, when you noticed how much less responsive the airplane was to elevator control input. As a result, you had to pull the elevator control aft a considerable amount to sustain the desired slow flight attitude. Additionally, the reduction in the wing’s downwash on the tail as a result of ground effect causes the nose to pitch forward with decreasing airspeed. This requires even more aft elevator (yoke) deflection (and pressure) to maintain the desired attitude for the landing flare.

That’s why, during the landing flare, you have to anticipate a relatively large aft movement of the elevator control to maintain flare attitude and control your rate of closure with the runway. Keep in mind that you’ve already gone through the motions of the landing flare even before you made your...
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Proper Trimming Helps You Land More Easily

In order to have more precise control of the airplane during the landing flare, make sure your airplane is properly trimmed for the correct approach speed. Without proper trimming on final, you’re likely to spend more time trying to acquire the feel for landing. Why is that? Read on.

An improperly trimmed airplane on final approach presents you with a different elevator feel each time you begin the flare. Your landing flare will be like the haircut a drunken hairdresser gives you—each one will be different (and that’s only good if you’re in the witness protection program). That’s why you should strive to ensure that the airplane is trimmed to maintain the same approach speed on every approach you make. At least that way when you begin the flare, the flight controls won’t suddenly feel too heavy (or too light) because of improper trimming. This unexpected feel on the elevator control could easily cause you to over- or under-flare during landing.

Sampling the Response

Keep in mind that, during the roundout and flare, the ideal landing technique is one where you pull back consistently and smoothly on the elevator as the airplane approaches the ground at an ever decreasing descent rate until the main gear wheels gently squeak onto the runway (the squeak being made by the wheels and not the pilot’s tiny biceps).
This ideal rate of aft elevator application is depicted by the yellow line in Figure 20. On the other hand, it’s not uncommon for student pilots to move the elevator control in an exaggerated back and forth motion during the flare (represented by the red line in Figure 20). Hopefully this isn’t followed by commentary such as: Oops, too much; oops, not enough; oops, too much: no, no, not enough, and hoo chee mama! What these students are doing is trying to compensate for over- or under-controlling pressures on the elevator during the flare. This certainly isn’t ideal, but the behavior will diminish once the student has more experience at landings.

This pull-and-push behavior on the elevator control by student pilots is understandable, given that as soon as the airplane enters ground effect, the downwash on the tail diminishes and the airplane pitches forward. Students typically overcorrect with an excessive aft pull on the elevator control. The amount of aft pull necessary to flare the airplane is compounded by the fact that the aft pressure required to keep the airplane in the desired flare attitude constantly changes with the reduction of airflow over the tail as the airspeed decreases. So it’s perfectly understandable that a student pilot might have difficulty finding the correct amount of elevator back pressure to apply.

At first glance it might look like landing a taildragger is something very different from landing an airplane with tricycle landing gear. Well, it’s not. Let me explain why.

The approach and landing of a taildragger is done in almost exactly the same way that it’s done in an airplane with tricycle landing gear. The only difference is that your objective in a taildragger is to touchdown on all three wheels at the same time for a normal landing. This is known as a three-point landing because all three wheels should touch the runway at the same time.

To accomplish this type of landing, you perform the roundout and flare at the same altitude that you’d use in a tricycle geared airplane. In a taildragger, however, your objective is to keep the airplane from touching down until it’s just a little above its stall speed. You accomplish this by holding the airplane off the runway while continuously reducing airspeed until you feel the wings are just about ready to stall. At that point, you let all three wheels to make contact with the runway at the same time. The wings are essentially stalled and the airplane has ceased flying.

The tricycle geared airplane lands at nearly the same nose-up attitude as the taildragger but it’s not necessary for the wings to be stalled at the moment of touchdown. Why? Because the moment the main gear touches down, the nose is gently lowered to the runway surface. This essentially reduces the wings’ angle of attack rendering the wings unable to generate the necessary lift for flight.

When you make a side-by-side comparison of a taildragger and a tricycle geared airplane landing, the only real difference between the two is that the tricycle geared airplane lowers its nose after the main gear contact the ground. The taildragger’s nose always remains pointed slightly above the horizon after touchdown.

Of course, after a taildragger touches down, you must apply your considerable rudder skill to keep the airplane aligned with the runway. Why? Unlike the tricycle geared airplane, the center of gravity on a taildragger is located behind the main gear. If the taildragger is allowed to swerve sufficiently at higher speeds, it’s possible for the nose and tail to attempt to switch places (the groundloop).
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There is, however, a very interesting technique that experienced pilots use to help them maintain the precise amount of elevator back pressure necessary to produce a smooth landing. Know as sampling the response, this technique allows them to precisely control the airplane’s rate of closure with the runway, thereby minimizing the chance of over- and under-flaring the airplane. Here’s how it’s done.

During the flare, apply continuous elevator back pressure but do so in small pull-and-release motions as represented by the green line in Figure 20. Think about pulling just far enough aft so that the nose would begin to rise beyond the desired pitch attitude if you pulled even a tiny bit more. As you hold the elevator at this position, you’ve technically arrived at a point that I call the threshold of control—a point at which pulling further would raise the nose. But, as we’ve just discussed, this threshold is always moving elevator-aft as you slow down, so you have to keep sampling the elevator response to maintain that threshold of control. It’s the constant recalibration of an aft moving elevator resulting from this pull-release motion that allows you to make the airplane’s nose stay right where you want it to stay, and lets you retain immediate control of the airplane’s attitude. This means that the airplane’s nose shouldn’t unsuspectingly pitch downward during the landing flare. (See Postflight Briefing #10-1 on Fanning for a little history and detail about this technique.)

Now, you’d think the plane would be jumping up and down like one of those mechanical bulls in a Texas bar. The pull-release motions, however, are small enough (if they’re done correctly) that no one in the cockpit will feel any vertical pitch acceleration. Nor will anyone inside or outside the cockpit see the nose pitching up or down. On the other hand, you will see the elevator control being

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Say “No Thank You” to the Landing Stall

One of the techniques pilots occasionally use (and, remarkably, instructors occasionally teach) in tricycle geared airplanes is to touch down at the precise moment the airplane stalls. Sometimes referred to as a full stall landing, the intent of this maneuver is to minimize the landing roll by reducing the airplane’s touchdown speed. The landing distance is affected by several things, such as wind, weight and speed; double the airplane’s weight and you double the energy that must be dissipated to bring the airplane to a stop. Double the speed, however, and you quadruple the energy to be dissipated during landing. So slower is better when it comes to getting the airplane stopped. But everything comes at a price, doesn’t it?

Trying to hold the airplane a few inches off the runway until it’s just about to stall means that at the moment of touchdown the wings are near their critical angle of attack. You now have zero margin to protect you from anything and everything.

In this condition, any wind gust or excessive pull on the elevator control can result in the airplane rising a few feet above the runway and dissipating the last of its energy. That’s when fall comes early. The result is a hard landing, perhaps better characterized as an abrupt arrival. At this very slow speed, the flight controls are relatively ineffective. If a wind gust raises one wing instead of the entire airplane, you could lack the control authority needed to return the airplane to a normal landing attitude. This makes it easy to bend your landing gear or lose control of the airplane on the runway or both.

A full stall landing also requires an increase in any crosswind correction you’re applying as you approach stall speed (more on crosswinds in the next chapter). Unless your timing is just right, it’s possible to run out of crosswind control response before the airplane has actually touched down. Oops. You’re landing north/south but the airplane is also moving east/west. The landing gear is not going to like this.

Yes, pilots essentially do full stall landings in a taildragger, but taildraggers touch down on three wheels at the moment of stall instead of two wheels for the tricycle geared machine. A three-wheeled base is more stable about the pitch axis than a two-wheeled base. Of course, taildraggers have their own special issues when landing, but the point stands, nevertheless.

In a tricycle-geared airplane, it’s best to touch down a few knots above the airplane’s stall speed, before the wings have stalled. Those few knots are your safety net, defending against gusts, ghosts, twitches, and other things that might or might not be of your doing.

Upon touchdown, you will of course gently lower the nose wheel to the runway surface to reduce the angle of attack, thus eliminating any chance of those wings allowing the airplane to lift off again.

Do not tell your instructor that hotrod Rod said you should speed down the runway to land. I’m advocating touching down at a speed at least a few knots above the airplane’s current stall speed, before the wings have actually stalled. Since airplane stall horns typically activate at three to four knots above stall speed, it’s possible you will actually hear the beginning of the stall horn on touchdown. That doesn’t mean the airplane is stalled. It does mean that you have control of the airplane all the way through the flare and touchdown.
moved aft with small pull and release motions during its travel. These motions are more visible on larger single-engine airplanes where the airplane’s mass requires a larger displacement of the elevator to change pitch slightly. The proper application of this technique requires proportionally smaller forward and aft yoke movements to remain in the threshold of immediate control when flying airplanes in the weight class of a Cessna 150 or J-3 Cub.

It’s worth trying this technique on a few landings to see if it gives you a better idea of how to flare your airplane. It’s certainly ideal to apply one continuous increasing pull on the elevator during landing, and you should always strive for the ideal. On the other hand, some folks have a difficult time flaring that way. So be it. While they may never be the Muhammad Ali of landings, at least they won’t float like a butterfly and land like a bee.

An exaggerated form of the sampling the response (pull-and-release) technique is frequently used by pilots operating deep in the region of reversed command while making short-field landings on extremely short fields. Slightly larger forward and aft movement on the elevator lets them know how much (if any) aft elevator travel is still available to them, as well as how effective the elevator response is. I’ll discuss this in greater detail in the chapter on short-field landing techniques.

As a final note on this technique, some pilots refer to this as fishing for the runway. OK, I’ll take the bait on that. This is a fishnomer (OK, misnomer). Fishing for the runway is supposedly something pilots do when they have no clue as to where the hard surface is below them. They push and pull on the elevator slightly, waiting for those wheels to make contact with the ground. This is more myth than reality. It’s actually quite rare to see a pilot fishing for a runway, though I’ve seen a few who hunted for one.

The Two Handed Flare

It’s not uncommon for many student pilots to try placing two hands on the yoke during the landing flare. This isn’t a wise idea for inexperienced pilots. So if you’re a student pilot, I want you to keep one hand on the throttle and the other hand on the elevator control during the roundout and flare. Why? Because it allows you to have immediate access to engine power in the event you over-flared the airplane or the airspeed suddenly decreases. Student pilots, with few hours in their logbooks, haven’t developed the necessary muscle memory to help them locate the throttle by feel. In other words, they aren’t yet skilled at moving their right hand from the right side of the yoke directly down to the throttle.

Now, there are circumstances where I have let students use two hands on the yoke when they are having trouble learning to flare the airplane. Two hands give them greater fidelity on the elevator control. However, I typically do this for two or three landings, at most. I occasionally allow this because it can help students stop extreme over-controlling movements of the elevator. It only takes a few landings with two hands on the yoke for most students to get an approximate sense of how much elevator input is needed during the landing flare.
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Arms Control—The Case for the Two-Handed Flare

Why would anyone even think about flaring an airplane with two hands on a typical wheel type yoke instead of keeping one hand on the throttle and one on the yoke? There are several reasons why doing so is a reasonable idea.

One is when a pilot finds it difficult to manipulate an airplane’s heavy elevator control forces, and the other is when an instructor needs a temporary technique to assist his or her student in the landing flare (as explained above). So let’s explore the former here.

Biomechanically, it’s simply easier to apply precise changes in elevator control pressure when you dedicate additional strength and more nerve endings to manipulating the control yoke. Two hands also provide better leverage. This is why some pilots opt to place both hands on the yoke during steep turns. Using two hands can also help overcome any binds or crimps in the yoke’s gearing mechanism, a common issue in older airplanes (and older pilots, too).

It turns out that some pilots flying larger single-engine airplanes occasionally use two hands to flare their airplanes. These are typically airplanes such as the Cessna 182 and 210, the Cherokee Six and Saratoga. The handy use of two hands for the flare helps pilots to obtain greater precision in pitch control when the yoke is either aerodynamically heavy (i.e., in slow flight), mechanically sticky or because the pilot’s physiology and seating position provides insufficient leverage on the yoke.

I am not talking about placing two hands on the elevator when the airplane turns final a mile out. I’m talking about using two hands on the yoke only in the latter portion of the flare when the plane is very close to the runway and the throttle is set at flight idle.

Some instructors ask, “What would happen during the flare if you encountered a gust, or heaven forbid, wingtip vortices, and had to apply power immediately? What about the critical time delay in finding that throttle? It could cost you your life.”

A bit of experimentation on my part several years ago revealed that the time it takes a rated pilot (someone with a private pilot certificate or better) to apply power from a two handed yoke grip is just a fraction of a second and could be even faster with a pre-application of adrenaline. This is in comparison to the standard one-hand-on-the-yoke and one-hand-on-the-throttle technique. It is difficult to see how one’s life hangs in the balance when an experienced pilot flares with two hands (under the previously stated conditions).

It’s possible, I suppose, that the rotational forces encountered in a wingtip vortex might result in an inability to properly project your hand toward the throttle, thus delaying the application of power. My standard response to this suggestion is that wingtip vortices are things you avoid, not things you handle. If you encounter an actual wingtip vortex that close to the ground, time-to-throttle is highly likely to be the least likely of your problems. That’s why we avoid wingtip vortices. That said don’t use two hands when you suspect vortices are likely.

I’ll reiterate that student pilots should always keep one hand on the yoke and the other on the throttle during the landing flare. This is simply good practice, given that students may not have enough practical experience to locate the throttle by feel or spatial memory.

Can a two-handed flare be done safely by rated pilots? The FAA thinks so, because it willingly certifies pilots having only one arm as described in Sherry Coin Marshal’s book, One Can do It (shown to the left). This includes one-armed pilots who aren’t required to use a prosthesis during flight. In fact, not only will the FAA certify one-armed individuals as private pilots, it has certified them as commercial pilots, flight instructors and multi-engine ATPs. We even have one-armed commuter airline pilots. Clearly, if a pilot only has one arm, that arm is on the elevator control when flaring the airplane, right? That means there are no hands left to place on the throttle. But it also means that the pilot can easily move his or her hand from one to the other and apply throttle quickly if that becomes necessary.

Ultimately, the ideal of having a hand on the elevator and a hand on the throttle is one we should honor. On the other hand (no pun intended here, honest!), it’s also reasonable for an experienced pilot to use a two handed flare when flying an airplane with a heavy elevator control or when an instructor wants to apply a temporary training antidote to his student’s excessive control inputs. Either way, this should be done only when the airplane is within a foot of the ground and with power at flight idle.

Over-control of the elevator during landing often stems from airplanes having poor elevator control leverage, sticky or worn elevator control gearing, or students with tiny little biceps that squeak when you pinch them. Most of the time this problem can be remedied with a bit of grease (no, not on those tiny biceps, either) or by proper use of the trim wheel prior to the roundout and flare. There is, however, a case to be made for use of the two handed flare if you’re a private pilot or higher. Read about it in the sidebar titled, Arms Control—The Case for the Two-Handed Flare.
Stabilized Approach

Here’s an idea that may help you better approach and land an airplane. The more time you have to observe the runway on final approach without the airplane pitching up, down, right and left, the easier it is for your brain to compute the rate of closure with the runway as well as your height above the runway. If you can better estimate these two things, landings will be a snap instead of something that causes the landing gear to snap.

When you’re having trouble learning to land, the objective for you and your instructor should be to arrive on final approach at least a half-mile from the threshold, at an altitude that allows a descent with minimal power changes (if power is being used). From this position, your objective is to establish the proper nose down pitch and power conditions for the target airspeed and descent rate, trim the airplane for this attitude, and use aileron and rudder control to keep the wings level and the nose pointed straight ahead (a no-wind condition is assumed here). This is what is known as a stabilized approach, and it offers you the best chance of making consistently good landings (Figure 21).

Once the airplane is stabilized on final approach, let it do as much of the flying as possible. After all, it already knows how to fly. Your sole objective is to keep the ever-expanding runway picture steady in the windscreen during your approach to it. Why? So your brain can do what it already does best, which is making estimates about your height and rate of closure with the landing surface.

Jumble the picture by wandering all over final approach and your brain can’t make these calculations as accurately. In fact, the stationary spot method for evaluating the landing location and the trapezoidal shape method of evaluating the glidepath angle are both based on your ability to keep the airplane stabilized on approach. Without stabilization, you simply can’t make out how the runway and its environment change during the approach. This would be similar to having a child in the back seat who puts his hands over your eyes and holds them there until you’re 10-15 feet above the ground. At this point the youngster removes those hands and says, “OK daddy, guess how high you are?” How can anyone make a reasonable estimate of roundout height in so little time?

Sometimes I have to remind students what they know as well as how to use what they know. An approach and landing is nothing but a wings-level, constant heading descent followed by a nose-up pitch at the appropriate time. This is why I often spend more time with new pilots initially practicing wings-level, constant heading descents. It’s also why I make a very big deal about properly trimming an airplane on final approach (or at any time, for that matter). When they can keep those wings perfectly level, the airplane pitched downward to a precise degree below the horizon to maintain the desired airspeed, and not let their machine wander away, they’ll be landing on their own in a short time. Of course, there’s much more to learn about landings and it takes several additional hours to cover all the essentials.
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The Touchy Touchdown

Right after a proper landing flare, the airplane will touch down on its main gear first, followed by a gentle lowering of the nose gear. This portion of the landing is known as (drum roll please), the touchdown. Who would have guessed? (Probably you.) The transition between the wheels touching down and the airplane decelerating on the runway is known as the touchdown roll (Figure 22). We’ll explore both here.

It’s important to understand that airplanes should not be forced onto the runway during the touchdown phase. Think “gentle art of persuasion,” not cage wrestling. You will rarely win a fight with an airplane.

You shouldn’t need to shove the elevator control forward to make the wheels contact the runway surface. The objective here is to have the main gear touch down before the nose gear while the airplane is under complete control. How smoothly this transition occurs is a matter of practice and experience on your part.

At the moment of touchdown, you must ensure that the longitudinal axis of the airplane is aligned with the runway (Figure 23). You have walking sticks (legs and feet). Make sure you use them just as the main gear is about to make runway contact. Push those rudder pedals as necessary to keep the airplane’s longitudinal axis aligned (parallel) with the runway centerline stripe. Now is not the time to become Twinkletoes.

Keep in mind that the rudder is still quite effective during the landing flare. So, if the airplane’s longitudinal axis is at some angle to the runway before touchdown, straighten it out by pushing on a rudder pedal. Push it as hard as necessary in order to point the airplane’s nose straight down the runway, and use those ailerons to keep the wings level.

I’m assuming a no-crosswind condition here. We’ll cover crosswind landings in the next chapter. Be assured that any normal or crosswind touchdown is accomplished with the airplane perfectly aligned with the runway’s centerline. To land at some angle to this centerline means that side loads are imposed on the landing gear. Under extreme conditions this could lead to tire or landing gear damage. It can also lead to a ground loop.
A ground loop is essentially a loss of control after touchdown. The name probably originates with the behavior of a taildragger, which tends to pivot about its main gear after touchdown because the pilot lost control of his or her machine (Figure 24). It does this because unlike a tricycle geared airplane, the taildragger’s center of gravity is located behind the main gear. This results in the front and back of the airplane wanting to swap ends if the airplane is allowed to swerve excessively during the touchdown roll. Swapping ends is not an advantageous position in which to place an airplane as it’s touching down.

In an airplane with tricycle gear, the machine can also pivot about its main gear, but because of the way mechanical forces are distributed, instead of the front and back ends swapping places the more likely outcome is a wing and/or prop strike or, in extreme cases, the airplane actually flipping over on its back and playing dead. That’s not a happy way to end a flight, is it? Your chance of groundlooping increases when the airplane’s longitudinal axis is misaligned with the runway centerline during landing. So the straight skinny here is to keep the airplane straight.

**Houston, The Eagle Has Landed**

Once those main wheels are on the ground, your job is to make sure they stay there. You have arrived, but you haven’t fully landed. Do not stop flying the airplane until you are at the tiedown spot and the engine is shut down. A little complacency goes a long way in the wrong way post-landing.

Since your main gear will (should) touch down first, the wings will still be at some positive angle of attack. A strong gust of wind can produce sufficient lift to raise the airplane off the ground, or lift one wing off the ground in the case of a sudden crosswind gust. It can also cause the airplane to float or skip sideways across the runway, thereby exposing the airplane to a ground loop and/or tire and gear damage. We’ve already discussed how discomforting this can be. That’s why you want to lower the nose gear smoothly and gently to the runway surface promptly after touchdown (Figure 25).

Notice that I said, “Promptly”? There is a far-too-prevalent view
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that it is ideal to hold the nose wheel off the ground as long as possible, making it look as though you’re doing a wheelie. I’ve been at airports where I thought all the landing airplanes were trying to “high-one” each other. I don’t know where this wheel deal idea started, but I know where it should end—on the ground. Holding the airplane’s wings at a high angle of attack after landing does create aerodynamic braking. But the idea that that’s how you stop a general aviation airplane is very peculiar and you should get away from it. You aren’t flying the space shuttle, and you haven’t re-entered the atmosphere from orbit where aerodynamic braking is necessary to help dissipate your re-entry energy.

You, lucky pilot that you are, have an airplane equipped with wheel brakes! So use them, but use them in the right way.

Some pilots suggest that aerodynamic braking saves brake pads. Well, that may be true, but the cost of brake pads pales in comparison to the risks of ground looping your airplane because you insisted or performing an Evel Knievel wheelie on landing.

Another reason we don’t use aerodynamic breaking is because it limits the ability to see what’s ahead of you on the runway. Aerodynamic braking is reasonable when landing on a long, soft field, as we’ll discuss in Chapter 12. Other than that, its risks far outweigh its rewards.

As you gently lower the nose wheel to the ground, the wings are at a very low angle of attack, producing little if any lift. As you apply the brakes gently, the airplane will tend to pitch forward about the main gear and compress the nose wheel strut mechanism (Figure 26).

Up to a point, that’s fine, but excessive compression of that strut can diminish the ability to steer the via the airplane’s nose gear steering mechanism (Figure 27). I don’t want to milk a dead cow, but no steer is no good. That’s especially true since the rudder is becoming less useful as a steering device as the plane slows. You need to be able to steer with something. That’s why you’ll want to reduce the compression of the nose strut by applying elevator back pressure during the deceleration (Figure 28). Apply just enough back pressure to prevent the nose strut from being excessively compressed but don’t lift the nose wheel off the ground again. As the airplane decelerates, you’ll have move the elevator control continually aft to reduce the nose strut pressure as the elevator control loses its aerodynamic effectiveness.
Stopping an airplane just after landing means transferring the weight from the wings to the wheels as quickly as possible. This provides for more effective braking and deceleration. On the other hand, immediately after touchdown even with the nose wheel contacting the surface, it’s possible that the wings are still developing a small amount of lift, which ultimately reduces braking effectiveness. An excessive application of brake pressure might result in skidding the tires. If you’re someone who likes to make a dramatic airport arrival, this isn’t the optimal way to do it.

If you sense that your tires are beginning to skid (it’s possible that you’ll hear or feel the skid), release the brakes and apply just enough brake pressure to keep the wheels from skidding. This is one reason why the maximum amount of braking effectiveness occurs in the last one-third of your total ground roll (Figure 29). In other words, if your performance charts suggest it would take you 600 feet to stop (the approximate distance between three sets of runway side lights along the length of the runway), then you can count on your braking action being most effective in the last 200 feet of the 600 foot ground roll (or, a single set of runway side lights). So don’t apply heavy braking immediately after touchdown. Instead, apply brakes slowly at first then progressively increase the pressure on the brakes as the airplane decelerates.

Another thing you want to avoid doing is trying to turn a tricycle geared airplane too sharply while braking. The typical scenario for this is trying to make an early (or the first) turnoff to exit
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the runway when you’re still moving along briskly. It’s easy to have the airplane’s momentum lift it to the right or left front quarter of its tricycle base, resulting in it toppling over like a child on a tricycle who makes a sharp turn (Figure 30). Then you’re doing a wing-y thingy. The potential for this happening is even greater if a quartering tailwind is involved. So decelerate straight ahead, then turn once the airplane is at or below normal taxi speed. Some airports have “high speed” taxiways, where the exit angle is more gradual and permitting a safe exit as a somewhat higher speed. That doesn’t however mean that you have to exit at a higher speed if you don’t feel it’s safe to do so.

Of course, the proper use of the ailerons to keep a wing from rising due to a crosswind is also a very important part of touching down safely. We’ll discuss proper use of the ailerons in a crosswind in the next chapter.

There’s a lot going on during the touchdown. That’s why you don’t want to be messing with things like flap retraction immediately after landing. Despite flaps handles being shaped like flat flaps and gear handles shaped like round tires, pilots can easily mistake one for the other during the landing roll (Figure 31). It’s that sort of thing that makes you—or your airplane—a sitting duck. Wait until the airplane has come to a complete stop off the runway before retracting the flaps. Doing otherwise means you might retract the gear (if it has retractable gear) and that means you’ll need a lot more power to taxi. That’s how you know you’ve landed gear up. (OK, just kidding on that one).

Using Flaps for Landing

What’s the flap about flaps? There isn’t much of a flap, actually. When an airplane extends its flaps (or sprouts aluminum), the size and shape of its wings are effectively altered (Figure 32). Now the wings are able to produce the required amount of lift at a slower airspeed. This can be easily seen in Figure 33.
Flaps provide a higher coefficient of lift for a given angle of attack. If you remember the lift equation in Chapter Five, the coefficient of lift is one of the direct multipliers in the lift equation. It’s very uplifting, sort of the bench-press of coefficients. Double the coefficient of lift and you double the lift produced by the wings. With an increase in lift, however, there’s also an increase in drag. What a drag, except when it allows the airplane to descend at a much steeper angle without an increase in airspeed. Let’s see how this works in action.

First, by applying some flaps on takeoff it’s possible for the airplane to become airborne at a slower speed and climb at a steeper angle. This is why some POH’s recommend the use of 10-25 degrees of flap extension for short-field takeoffs (more on short-field takeoffs and landings in the Chapter 12). Since flaps also reduce the airplane’s stalling speed, landing with flaps extended substantially reduces the airplane’s landing roll, too. This is why short-field landings (especially when an obstacle is involved) are flown with full flaps. This allows a steeper descent over the obstacle at a slower speed, resulting in a shorter ground roll after touchdown (Figure 34).

Depending on the specific type of flaps involved, flap extension might cause the airplane’s nose to pitch upward or downward or upward with partial flaps and downward with full flaps as they are extended. It’s important to counter this pitching tendency by using the appropriate elevator pressure. This action helps prevent large swings in airspeed. Once applied, the airplane should be retrimmed to maintain the desired attitude and to remove excessive elevator control pressure.

If you find yourself high on final approach, it’s certainly appropriate to apply full flaps and simultaneously lower the nose to maintain the desired approach speed. In doing so, your descent rate and descent angle will increase.

If, however, you have flaps applied and you find that you are going to undershoot the runway, you don’t want to remove the flaps unless you are beginning a go around and only then after adding full power (go rounds coming up next). Instead, you want to apply power—probably a lot of power—to change your glidepath. Removing flaps at the lower power settings associated with descents might...
cause the airplane to stall or to move into the region of reversed command, making a climbing recovery difficult, if not impossible.

When using full flaps for landing, there are two important items to consider. First, the nose is generally placed at a lower attitude when making a full flap approach (Figure 35, position A). More drag means that you must point the nose down more to allow gravity to sustain your descent speed. That means the roundout and landing flare require a rotation through a larger arc compared to rotating in a no flap condition (Figure 35, position B). Combine this with a slightly higher descent rate and it’s clear that you must apply elevator back pressure for the landing flare at a slightly faster rate than you would in a no flap condition.

You also won’t have as much time to make small corrections in pitch during the landing flare. Why? Because the lower approach speed along with the drag associated with the use of full flaps results in the airspeed decreasing to stall speed quickly (relative to a no-flap landing). Ultimately, this means that if you begin the roundout too high above the runway or overflare during a full flap landing, you might be too high and/or at too slow an airspeed to recover by lowering the nose and attempting acceleration for another landing flare. So, when landing with flaps, you want to be ready to use engine power to help compensate for any overflare or bounce upon landing. Of course, the degree to which any of the above happens with full flaps depends on the type of flaps on your airplane. Some flaps (think plain flaps) just aren’t as effective other types of flaps (think Fowler flaps).

**The Go Around**

You’re about to learn why sometimes the most important landing maneuver is not landing.

Sometimes, no matter how much you want to land, the universe seems to do everything possible to prevent a smooth return to earth. You might be on final approach when someone decides to use the runway for takeoff (Figure 36) or a pickup basketball game. At other times some official representative of nature such as a deer or coyote might run out onto the runway. Shouting, “Oh, deer” is usually useless, especially if it’s a coyote. And sometimes your approach is just not as stable or doesn’t
feel as safe as you’d like it to be. These are the times when you must quickly reconfigure your mind and your airplane; both were set up to land, and now must be briskly transitioned into the right attitude for a go around.

The go around is just what the name says—you go around and try again. The go around is a maneuver that can be started at any altitude. You must be mentally and physically prepared to initiate a go around at any moment until the airplane is on the ground and safely off the runway (Figure 37).

Whether at 500 feet or in the flare, all go arounds begin the same way—with the application of climb power (Figure 38). Smoothly move the throttle handle forward. Don’t jab it into and through the instrument panel. If carburetor heat had been applied, it should be turned off in order to maximize power production.

Because you’ve probably had the airplane trimmed for landing, when you apply climb power with flaps extended the airplane will tend to pitch nose-up quite dramatically. You might need to apply a great deal of forward elevator pressure to keep the nose attitude from increasing excessively. You’ll also need a lot of right rudder to compensate for the airplane’s left turning tendency with climb power applied (Figure 39).

Your objective after power is applied is to select an attitude that allows the airplane to accelerate to climb airspeed. In most instances, the airplane is already close to its climb airspeed so climb attitude can be immediately selected.
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On the other hand, as you add power and raise the nose to begin a climb, you don’t want to raise that nose too fast. Depending on the power available to you, the size of your machine, the type of flaps and the amount they’re extended, the airplane simply might not accelerate quickly. Allowing the airplane to pitch up too early in this situation could easily increase the induced drag associated with slower speeds, nudging you into the region of reversed command and dangerously close to a stall.

So be prepared to keep the nose a bit lower than the desired climb attitude to accelerate properly. Only when the airplane is accelerating should you raise the nose and begin your climb. Be sure to use whatever nose-down trim is needed to help you maintain the desired attitude.

Time to kick back and open a cooling air vent? I don’t think so. You still have work to do. You’ll want to clean up the airplane once it begins accelerating. This doesn’t mean picking up empty juice boxes and cookie wrappers. Now is when you put the airplane into an aerodynamically cleaner configuration by retracting the flaps and landing gear (assuming it is retractable, of course).

If you’re flying a non-retractable geared airplane, you only need to clean up the flaps during the climb. Start by reducing your flap setting to partial flaps first. This means ridding yourself of the major drag causing portion of the flaps. When you’ve established a positive rate of climb (meaning that the needle on your VSI is deflected upward), raise the gear if you’re in a retractable. As the airplane continues to accelerate, remove the rest of the flaps in 10-15 degree increments. In airplanes having three notches of flaps (or three nachos of flaps if the airplane is from south of the border), flaps retraction typically means removing the last notch of flaps, followed by the other two notches with brief time intervals between each retraction. Of course, it’s your POH that is the final arbiter about how flaps should be retracted in this condition.

Doing things in this order is the most reasonable means of transitioning from a dirty, high-drag airplane to a clean, low-drag one. Then get the kids to pick up the empty juice boxes and cookie wrappers.

Did you notice that I said to reduce flaps to their partial setting, but not to raise the gear until you’ve established a positive rate of climb? Think of this as an insurance policy. The plane is at or near the ground and headed downward. Even though you’ve applied power, there is a slight lag until the plane accelerates and removing flaps could cause the plane to settle slightly before it starts moving upward. If that happens, would you rather have the gear or the belly touch down?

That said, touching down during the go around is more likely if you happen to be flying a larger airplane having a lot of inertia. The point here is to have the gear out there to keep the airplane from contacting the runway.

If flaps are such a drag, why don’t we just retract them completely as we begin a go-around? Because removing flaps at the lower power settings associated with descents might cause the airplane to stall or move into the region of reversed command, making a climbing recovery difficult, if not impossible. So, first dump the last 10-20 degrees or so of flaps (based on your POH’s recommendation, of course).
Balked Landing Recovery Secrets

Simon & Garfunkel said there are 50 ways to leave your lover. There are at least four common ways to depart from a picture-perfect landing. A balked landing (which is just another way of saying that a pilot messed up the landing) often results from a porpoise, float, balloon or bounce. If you want to try making this an Olympic event, combine two or more of these options. Believe me when I say that all pilots who’ve landed more than four times have done all four. That’s a fact. Good pilots, however, know how to correct for these events and turn a balked landing into a good landing. Let’s examine each one individually.

Porpoising

Porpoising (the kind that actually resembles a porpoise popping in and out of the water) can occur if you attempt to force the airplane onto the runway at a higher-than-normal speed. This forces the nose gear to contact the runway slightly before the main gear does (Figure 40). It can also occur if you land hard on the main gear, resulting in the airplane pitching forward onto the nose gear. Either way, the airplane responds by pitching up and becoming airborne. Many pilots react to this by applying too much forward elevator pressure, resulting in the nose gear once again making hard contact with the runway. Boing, boing, boing. The cycle repeats itself, often with more devastating oscillations each cycle, until finally the nose gear collapses and the flight ends with a phone call to the insurance adjuster.

Here’s how to handle the porpoise. The moment the airplane’s nose gear contacts the runway and the airplane pitches up, you want to avoid shoving the nose down again. Instead, you’ll lower the nose to maintain your airspeed but you won’t shove the elevator forward to do so. You’ll simply release the elevator back pressure you’re most likely applying and gently let the
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airplane return to the runway where you’ll commence flaring at the appropriate height (Figure 41). Of course, you’ve probably lost a lot of airspeed in the process of pitching upward. Therefore, you should be ready to add whatever power is necessary to retain (or regain) your airspeed as you move closer to the runway. As you release that elevator back pressure, don’t be afraid to move that throttle to its full forward position to increase your airspeed if you manage to get too slow during the bounce. As a general rule, the higher the bounce after the first porpoise, the slower your airspeed becomes and the more power you need to regain that speed. When you are once again at flare height, reduce your power to idle and flare.

Inexperienced pilots can learn to handle this problem by having an instructor simulate porpoising on landing, then practicing the appropriate defense. At a slightly higher-than-normal approach speed, the instructor can simulate the initial bounce of a porpoise by letting the main-gear wheels touch the runway (not the nose gear wheel!), then pulling back on the yoke gently and just enough to raise the airplane about two feet into the air.

At this point, after having followed the instructor through on the controls, the student takes the controls and practices the recovery. Release a little of the aft pressure applied, letting the airplane settle toward the runway and then continue to flare the airplane. What you don’t want to do when you take over is shove the yoke forward. That’s what gets you in trouble to start with. So the tip here is to release a little of the elevator pressure if the airplane porpoises. Free Willy!!

If you fail to release elevator back pressure soon enough, the airplane keeps rising and the speed keeps falling. You see where that winds up, right? Most likely in a stall several feet above the ground and a very hard landing. Using your slow flight and stall experience, you should know when the airplane is getting too slow to go. The feel of the controls, the high pitch attitude and the stall horn are good indications of this condition. High pitched sounds from the flight instructor can also be a sign of an impending stall.

And always keep the go-around option in mind. Always. Sometimes, too much is going too wrong too fast. It happens. Don’t force the situation, especially when you are inexperienced. If you can’t get solid control quickly, don’t hesitate to go around. Consider it part of your education. A go around is a lot better than a wraparound prop.

Fig. 41

Proper Recovery From the Porpoise

1. Nosewheel contact

2. Recover by reducing elevator back pressure, adding power to regain airspeed, then reducing power and flaring for landing

To recover from the porpoise, you should avoid pushing forward on the elevator after the first bounce and, instead, simply lower the nose and add the appropriate amount of power to generate a less steep glidepath to the runway. Power should be reduced to flight idle at flare height followed by a normal landing flare.
Floating

Floating during the landing flare is the result of an approach airspeed that is too high. Landing is an exercise in energy management. Ideally, you arrive at the touchdown point with just enough energy; not too much, and not too little.

To float means that your airplane has too much energy—too much forward speed—to descend when you get to the spot where you’d like it to descend. The excess energy has to be dissipated before you can be repatriated with the runway.

You can’t hold an energy yard sale, so the only option is to keep the airplane close to the runway while slowly pulling aft on the elevator to reduce the airspeed and increase induced drag. Depending on how fast you are going, it might be necessary to just fly level above the runway for a while before you can even start pulling the elevator control back. Pull back too soon and you balloon (see next section). But try and force the airplane onto the ground and you will porpoise for no purpose.

The problem with floating is that you can either run out of runway on which to land (Figure 42) or be blown off the runway by a crosswind for which you don’t adequately compensate. Neither of these is much fun. Here’s how to handle this problem.

If you find yourself floating during landing and aren’t sure whether or not you have enough runway on which to land then go around. If there is any doubt in your mind about whether there’s enough runway left, go around before that option isn’t an option. One of the interesting things about runways is how much shorter they look when you’re running out of them. And there are few things more useless than the sky above you and the runway behind you.

If you’re convinced that you have sufficient runway, make sure power is reduced to idle and allow the airplane to remain at flare height, but don’t shove the elevator control forward to get there. Let the airplane decelerate while it settles slowly to the runway. Do, however, keep the airplane in either a crab or sideslip condition to prevent drift (crosswind correction, to be discussed next chapter). Preventing drift is of course the big challenge associated with floating. So if you find yourself floating, you’ll have to work hard at keeping the airplane positioned over the runway centerline.

As the airplane slows down to a normal roundout speed, you’ll have to increase the crosswind correction to compensate for wind drift. This means you’ll have to turn more into the wind to increase

Floating and Why It’s Not a Good Thing

It’s easy to float if you carry too much airspeed into the roundout or the flare. You have to dissipate the airspeed somewhat and, if there is insufficient runway on which to land, the best option is often to execute a go around and return for landing.
the crab angle. If you’re using a sideslip, you’ll need to increase your sideslip angle while keeping the longitudinal axis parallel with the runway. Increase the crosswind correction as necessary to keep the airplane tracking down the centerline of the runway until a touchdown can be made. We’ll discuss crosswind landings in detail in the next chapter.

**Ballooning**

One of the more common experiences that even high time pilots have is an increase in airplane altitude as they flare (Figure 43). This is called *ballooning* because the airplane moves upward during the landing flare instead of settling toward the runway.

Ballooning is different than porpoising. The porpoise usually results from bouncing off the runway, while ballooning results from excessive speed during landing, coupled with aggressive elevator technique in the flare where the wheels never actually touch the ground. It can also be caused by wind gusts or convective (rising hot air) currents in the runway environment.

As mentioned above, you are in an energy manager. Arrive hot at the landing spot, pull back abruptly (or sometimes even slightly) on the yoke, and the landing goes up instead of down.

In most cases, you can arrest ballooning behavior (no badge required, either) by simply releasing some back pressure on the elevator, followed by a normal increase in back pressure to continue the landing flare.

Releasing elevator back pressure might not be the right answer if the airplane’s speed is too slow and its altitude too high. In that case, you’ll want to release back pressure and apply generous amounts of power (perhaps even full power) to accelerate to a safer speed while returning to flare height and flare speed. At flare height, reduce power and commence a normal landing flare.

Once again, if it doesn’t feel good, don’t do it. A go around is your friend if you don’t feel you can get the airplane under control and down on the runway that remains.

If you manage to balloon during landing because you pulled aft too aggressively on the elevator, then release that elevator pressure and be prepared to add a lot of power (perhaps full power) to regain the necessary airspeed to flare for landing.
Bouncing and Why It’s Not a Good Thing

Bouncing

Bouncing is similar to ballooning in that it’s an upwardly-mobile airplane. However, the cause in this case is hard contact of the main gear with the runway. This can happen because of a flare at too high an altitude, or a failure to properly decrease the descent rate. I think this is where the term Baby Boomers comes from.

In a bounce, the airplane’s spring-like main gear launches the airplane back into the air at a relatively slow speed (Figure 44). Because things happen faster during a bounce (as compared to ballooning), you need to respond faster. This usually means adding climb power and pointing the nose slightly below the horizon to accelerate the airplane as it returns to flare height. If you don’t get some power under you, the plane will bounce again. And again. And again. And somewhere along the way the porpoise might come to play.

So don’t be afraid to push that throttle forward. Push it! Don’t wimp out on me here. Machiavelli is all for your power grab in this circumstance. Grab that power lever and power up as necessary. Here is where you have a need for power and speed. When the airplane is within flare height of the runway, reduce power and commence a normal landing flare.

These suboptimal landings can be challenging to explain to passengers. You can try saying you needed to get the dust off the plane, or that you’re doing routine, required testing of the shock absorbers. You can also try telling your passengers that you experienced a microburst as a reason for landing hard, though they may suspect a microbrew was more likely at fault.

Believe me when I say that everyone, and I do mean everyone, lands hard on occasion.

More Advanced Landing Skills

Now that you have a basic idea of how to round out and flare the airplane for landing, it’s time to talk about how to land when the wind blows from some place other than directly down the runway centerline. Crosswind landing skill is a must if you hope to fly relaxed, to say nothing about staying on the runway. So let’s see how to handle crosswind landings so as to not get crossed by the wind.
Chapter 10: The Roundout and Flare

Fanning? No, this is not something you do after landing hot.

Fanning the elevator is similar to the technique we covered on Page 10-15 called sampling the response. There is, however, a distinct difference between the two techniques. Sampling the response requires small forward and aft movements on the elevator control during the flare to maintain precise control of the landing attitude. Fanning, however, involves similar movements performed in a slightly quicker and exaggerated manner. While all pilots might sample the response when landing an airplane, student pilots are sometimes taught to fan the elevator to learn how to land an airplane. Said another way, flight instructors often introduce their students to fanning for a short period of time to help them develop the proper landing behaviors.

I first encountered the technique of fanning when I began flight instructing in the early 1970s. There were still quite a few WWII flight instructors around that were active in flight training. These instructors were very familiar with the concept of fanning.

Fanning, however, is a technique that even precedes WWII. I first read about it in Barrett Studley’s 1928 flight training book titled, Practical Flight Training (Figure 45). Studley was a Navy flight instructor, teaching in an NY-1 Navy taildragger. Here’s how Studley describes the technique of Fanning:

Fanning—Difficulty is usually encountered with normal landings, and if so, fanning may be employed temporarily to familiarize the student with the process of stalling in the air and dropping onto the surface.

Of course, taildraggers are often landed in a stalled condition, but there’s essentially no dropping onto the surface except from just a few inches. Studley’s point, however, is that fanning is a practical method of helping students learn to land.

When a student fans the elevator as he begins the roundout and continues through the flare, he is essentially pulling the elevator farther and farther aft, but doing so in a series of quick aft stick movements. Studley expresses the idea this way:

The plane is leveled off...by a series of quick backward movements of the stick. These movements are continued in order to raise the nose until the airplane stalls. After each one [aft stick movement] the stick must be allowed to go forward again, as if it is held back even momentarily the plane is likely to climb. (See Figure 46.)

Yes, it’s true that at this early stage of landing, the nose is indeed moving up in small increments. No, it’s not oscillating up and down as might be surmised from the small aft (and release) stick movements. Instead, the nose is being raised in small but distinctly visible increments, somewhat similar to applying aft pressure on a lever via a pulley system to raise a heavy weight. These increments should not be jarring or necessarily jerky if the technique is performed properly.

Studley expresses the point this way:

Control is maintained by a slight excess in the magnitude of backward movements of the stick, which causes the nose to rise in a series of small steps following each other in rapid succession.

The idea of fanning is based on the student having an opportunity to make, recognize and correct for the mistakes he or she is likely to make with the elevator during the first few hours of training.
That’s right. Fanning is ultimately a mistake-making technique. It’s the chance to see tiny little mistakes (raising the nose in small increments) then correct those mistakes—lots of them—that allows an acceleration in learning. Here’s how Studley states it:

...tendency to keep the stick in more or less constant and regular forward and backward motion. The net result of this will be a marked decrease of the fluctuations in the plane’s height. This tendency is normal at this time, as the student can progress only by making, recognizing and correction mistakes. Free use of the elevators is one of the first things that must be learned.

The idea of fanning might appear to be more complex than just teaching someone to make a continuous aft pull on the elevator for landing. This, however, wouldn’t comport with reality. Fanning is actually much easier on the beginner than learning to use a continuous, precise aft pull on the elevator for rounding out and flaring. Studley explains it this way:

While learning to land, it is simpler to keep approximate control of motion already initiated than to commence movement of the elevators at the proper instant and control its magnitude precisely.

Keep in mind that the objective of fanning is not to use it as the final skill one will use when landing. Instead, it’s simply a step toward making a smooth continuous pull on the elevator for landing. Speaking early in the last century, Barrett Studley’s words on this matter still ring true. Studley says:

Fanning is suggested, not as a method of landing, but solely as a step in instruction. After ten hours it indicates lack of adequate control of the plane. But during the period from three to five hours it may enable the student to learn more quickly two vitally important things: (1) to move his stick freely; (2) to recognize the feeling of a landing made by his own handling of the elevators. He of course makes mistakes, but quickly learns to feel for and to recognize a stall in the air preliminary to a proper landing. Once he has actually accomplished this a number of times by his own efforts, he acquires a much clearer understanding of the process and greatly increased confidence in himself.

If fanning is used it should be commenced during the third or early in the fourth hour. By the end of the fifth hour the student should be able to land consistently by its use. The excess motion of the elevators must then be steadily decreased until it is practically eliminated. Otherwise precision will be seriously interfered with. Prior to the first solo consistently good landings should be made without frequently repeated forward movements of the stick.

Keep in mind that fanning is not the same as sampling the response. Fanning is an exaggerated but similar technique that’s used to help students learn how flare their airplanes for landing. Sampling the response is a technique typically used by rated pilots to flare their airplane. So add this to your bag of flight instructor techniques. You might find it useful. Your author certainly has.