

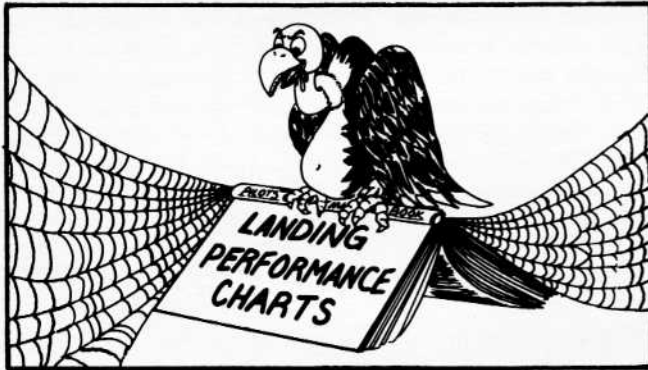
ON LANDINGS

Part II

Now let's look at two kinds of landing accidents that are "complementary." By that, we mean that, in some cases, "If the first one don't get you, the second one will." These are landing long and the poorly executed go-around.

LANDING LONG

When was the last time you looked at the landing performance charts for the aircraft you fly?



Aircraft performance charts are presented in one of two different formats: graphical and tabular. Some performance charts provide different approach speeds for different landing weights, while others provide only the maximum weight approach speed.

How many factors affect the length of your landing roll? Of course, there's landing speed and landing weight. There's also wind and density altitude (which is the combination of pressure altitude and temperature). Did you remember runway slope and runway surface? They affect braking. Runway length itself is also a factor, since it affects where you locate your aim point.

These eight factors must be thoroughly understood and controlled to avoid the hazards of landing long. Let's start with airspeed control.

Airspeed Control

Airspeed control is the most important factor in achieving landing precision. The secret of precise airspeed control begins in the traffic pattern with the stabilized approach.

Begin mastering airspeed control by checking "the numbers" in your Pilot's Operating Handbook (POH) or Owner's Manual. You should know and use the appropriate airspeeds for each segment of your approach. If you can't locate them, get help from a knowledgeable flight instructor. But again, manufacturer's numbers should be used when available.

On short final with wings level, your airspeed should be at the recommended approach speed. If that speed is not stated, use 1.3 V_{so}.

Although the official definition of V_{so} is qualified in many ways, for purposes of this discussion, V_{so} is the calibrated power-off stall speed of the airplane in the landing configuration and usually with a forward CG.

There are a few times when the use of 1.3 V_{so} on short final is not acceptable. First, the recommended approach speed for twin engine airplanes is at or above Vy_{se}, the best single engine rate-of-climb speed, which may be more than 1.3 V_{so}.

Second, the presence of strong, gusting winds is a problem to be discussed later.

Also, if you are unfortunate enough to be trying to land with an unwanted load of ice (did anybody ever land with a *wanted* load of ice?) the stall speed will be much higher than normal. If you carry too much airspeed at the moment of touchdown, your roll-out distance ratio will increase by the square of the ratio of your actual touchdown speed over your normal touchdown speed.

ROLL-OUT DISTANCE RATIO

EQUALS . . .

$$\left(\frac{\text{ACTUAL TOUCHDOWN SPEED}}{\text{NORMAL TOUCHDOWN SPEED}} \right)^2$$

For example, if an airplane that should be landed at 50 knots touches down at 55 knots (10 percent faster, or a factor of 1.1), the ground roll-out distance will be increased by the *square* of this factor, or 1.21, if *all other factors are constant*. The distance used from touchdown to a full stop will then be 21 percent greater than for the minimum touchdown speed. This could be ample justification for a go-around.

$$\left[\frac{\text{V ACTUAL TOUCHDOWN SPEED}}{\text{V NORMAL TOUCHDOWN SPEED}} \right]^2 = \text{ROLL-OUT DISTANCE REQUIRED}$$

EXAMPLE:

60 KNOTS — ACTUAL TOUCHDOWN SPEED

50 KNOTS — NORMAL TOUCHDOWN SPEED

OR, $\frac{60}{50}$ — A FACTOR OF 1.1 OR 10% FASTER

$(1.1)^2 = 1.21$

21% MORE RUNWAY REQUIRED FOR ROLL-OUT.

An approach flown at 70 knots, or 20 knots faster than your normal approach speed, will require 96 percent more roll-out distance, or nearly double the runway for roll-out alone.

$$\left(\frac{70}{50}\right)^2 = (1.4)^2 = 1.96$$

OR . . .

96% MORE ROLL-OUT DISTANCE REQUIRED

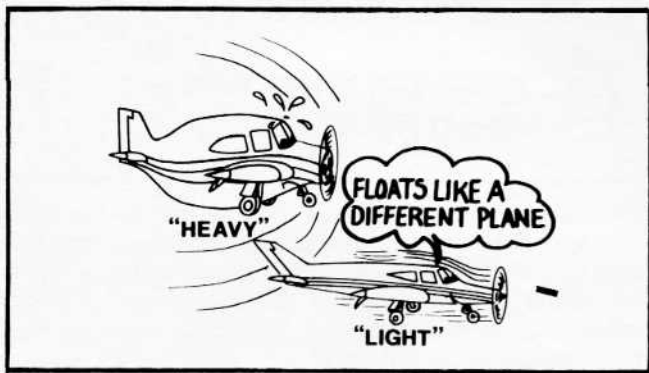
However, at anytime, if you happen to be carrying extra airspeed in the flare, the airplane will float, that is, glide from over your aim point, past the intended touchdown point, until that excess airspeed has dissipated.

Sometimes at a busy airport you're asked to keep the speed up, then land short, and turn off quickly. This can be tough and requires concentration and control. There may be situations where your best and safest option is to tell the air controllers "unable to comply."

Landing Weight

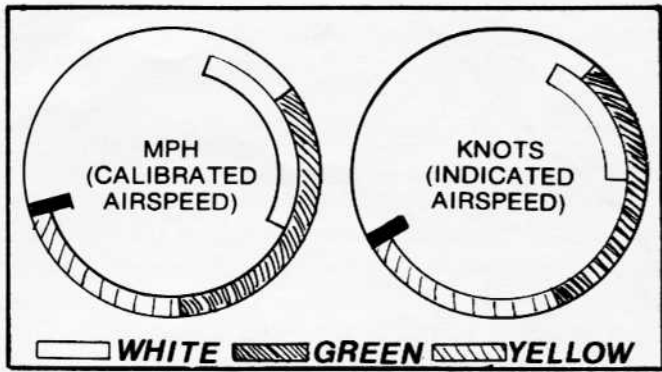
There are other factors that also lead to landing long.

Did you know that landing "light" can also mean landing long?



Remember, the 1.3 V_{so} formula is based on the *actual* weight of the aircraft, not the maximum landing weight. If you use your customary max weight 1.3 V_{so} number all the time, you'll "float" as the airplane dissipates the excess energy. Assuming that you'll want to land at or close to the stall, runway distance will be eaten up during the process.

There has been a lot of confusion about this. Many pilots assume that the "lower end of the white arc" on the airspeed indicator is V_{so} for all landing weights. It is not! It's really the stall speed for maximum landing weight at the most unfavorable CG within the allowable loading range. Depending upon the aircraft's year of manufacture, this "lower end of the white arc" could be marked in either calibrated, or indicated airspeed.



Larger aircraft above 12,500 pounds have detailed and very specific information to determine V-ref for all landing weights as well as other approach speeds at various flap settings. This information is needed for the simple reason that all aircraft stall at slower speeds when they are lighter. In the case of an airliner, that difference in weight can be measured in tons. In a light aircraft, the difference of a few hundred pounds in landing weight can make a similar difference.

THE AIRSPEED INDICATOR—BEWARE!!

A fine point, but a very important one—airplanes manufactured *before* the mid-1970's had their airspeed indicator color-coded speed range arcs marked in *calibrated* airspeeds, and shown in miles per hour. (Some were marked in both mph and knots.)

To determine 1.3 V_{so} at maximum landing weight for airplanes built *prior* to the mid- to late 1970's, multiply the *calibrated* V_{so} airspeed, (given in the Owner's Manual or marked at the bottom of the white arc), by 1.3.

Most airplanes built *after* that the mid-1970's had their airspeed indicators marked in *indicated* airspeed. Check the manufacturer's information about this for *your* specific airplane.

For most aircraft built since the mid- to late 1970's, you must use the calibrated airspeed values as published in your handbook. This is because calibrated airspeed is indicated airspeed corrected for position and instrument error (or what the "perfect" airspeed indicator system would show). Calibrated airspeed should *always* be used to calculate the proper approach speed at any landing weight, and then converted to indicated airspeed for practical use.

STALL SPEED WITH LANDING FLAPS
↓
AT MAX LANDING WEIGHT

KIAS	40	50	60	70	80	90	100	110
KCAS	50	55	62	71	80	90	99	110

AIRSPEED CORRECTION TABLE
(FICTITIOUS AIRPLANE)

You should do this because, for some airplanes, the indicated airspeed near the stall has a significant error.

As an example: if, by mistake, indicated airspeed is used as the maximum weight stall speed V_{so} (here it's shown as 40 knots), 1.3 V_{so} would be 1.3 times 40, or 52 knots IAS, or about 57 knots, CAS (using the table), giving a margin of only seven knots above the 50 knot CAS stall speed.

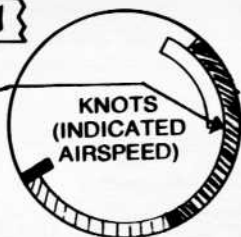
KLAS	40	50	60	70
KCAS	50	55	62	71

1.3 X 40 KNOTS = 52 KNOTS IAS (OR ABOUT 57 KNOTS CAS). THE AIRPLANE STALLS AT 50 KNOTS CAS, GIVING A FACTOR OF $\frac{57}{50}$ or 1.14 NOT 1.3

However, using calibrated airspeed as $V_{so} \dots 1.3 \times 50 = 65$ knots CAS. Referring to the correction table, the indicated airspeed for an approach (at max landing weight in smooth air) would be 63 knots IAS, giving an actual safety margin of 15 knots above the "real", or calibrated stall airspeed. However, it will look like a margin of 23 knots on your airspeed indicator!

KLAS	40	50	60	70
KCAS	50	55	62	71

63 KNOTS IAS



This is how you can estimate the approach airspeed for airplanes that do not provide approach speeds as a function of reduced landing weight. For airplanes without a table of approach speeds as a function of reduced weight, a rule-of-thumb is to reduce the calibrated approach airspeed for the maximum weight of your aircraft by one-half of the percentage of the weight decrease.

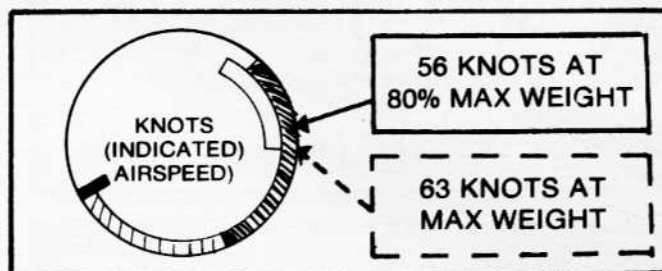
For example, if the airplane's weight is 20 percent below maximum, you would decrease the approach calibrated airspeed by one-half of that, or by 10 percent.

EXAMPLE:

$$\text{WEIGHT DOWN} - 20\% \quad \frac{20\%}{2} = 10\%$$

THEREFORE DECREASE APPROACH SPEED 10% (FROM THE APPROACH SPEED OF 1.3 V_{SO} AT THE MAXIMUM LANDING WEIGHT).

Example: for an airplane with an approach speed of 65 knots CAS at maximum landing weight (found earlier by multiplying the landing speed V_{so} by 1.3, i.e., 1.3×50 knots = 65 knots CAS), if you fly an approach with a 20 percent decrease in weight (or at 80 percent of the maximum landing weight) the new approach speed would be 65 knots (minus) (10% of 65), or 59 knots CAS, or 56 knots IAS, according to the correction table.



Remember, 1.3 V_{so} gives you a safety margin, but only after all maneuvering is completed. So use 1.3 V_{so} on short final only.

A warning about setting up your own approach speeds: The manufacturer may require a particular approach speed for all weights because during certification flight testing it was found that for stability and control reasons, or for go-around safety, a fixed speed is required. Check on this for your airplane.

Wind and its Impact on Landing Long

Wind is another major factor in landing long. To determine the effect of wind on landing roll-out, consult your performance charts. But you might be surprised to learn that a light headwind is not to be counted in rule-of-thumb computations for a decreased landing roll unless it exceeds ten percent of your touchdown speed.

Any tailwind does have a significant impact on your landing roll-out, and has the same effect as excess airspeed on touchdown in no-wind conditions. So beware!

A tailwind compounds your landing roll-out distance by the square of the ratio of the tailwind component, plus your "actual" touchdown speed over your normal touchdown speed.

INCREASE IN ROLL-OUT DISTANCE

EQUALS . . .

$$\left[\frac{\text{TAILWIND COMPONENT} + \text{ACTUAL TOUCHDOWN SPEED}}{\text{NORMAL TOUCHDOWN SPEED}} \right]^2$$

