The Only Way to Glide

How to stretch your chances when the rubber band breaks

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■■ The sectional chart isn't thought of as a lethal weapon. But to those of us who learned to fly in tandem-seat trainers, the sectional was something to fear.

The instructor sat behind the student in many of those rag-covered taildraggers. And since soundproofing had yet to be discovered, cockpit communications varied between limited and impossible. Rather than yell and scream over the engine and air noises, the CFI often found it more convenient to indicate his displeasure with a student's performance by simply beaning him from behind with a rolled-up sectional. The student worked hard to please his mentor, if for no other reason than to stave off this dreaded assault.

According to my instructor, Mike Walters, a chart would last for 6 to 8 hours of dual instruction before losing its rigidity. But on October 3, 1954, I proved that the 25¢ charts simply weren't as good as they used to be. On that memorable day, Mike lost his cool and "totalled" a brand-new chart with unmerciful blows to my cranium.

Mike was giving me post-solo dual in 180-degree, power-off approaches. My airspeed varied from less than 50 mph (when I was low) to more than 90 mph (when I was high). But despite and because of these sloppy efforts, I never came closer than 500 feet to the elusive touchdown target. Consequently, I was earning about four whacks per approach which did little to bolster my confidence. Once, when I turned to ask Mike a question, I caught a blow on the nose and learned not to argue with Mike.

During the last circuit of the day, Mike screamed a dialogue that can't be quoted here. Every other sentence, however, contained the term "normal glide," but I was too busy nursing my wounds to pay much attention.

The post-flight briefing was short and to the point. "Look, Barry," began Mike's abbreviated tirade, "One of these days that little 'four-banger' under the cowling is gonna quit. Your cork will unplug and down you'll go. And unless you learn something about glide path control, you can forget about being able to glide safely into a small landing area."

Totally embarrassed, I paid for the lesson and lowered my head in shame, hoping that Mike would notice the welts on the back of my neck and offer a rare word of kindness. No such luck. Mike turned away disgustedly, walked to the filing cabinet and withdrew a new sectional chart in preparation for his next victim.

As the log books began to pile up in the closet corner, I learned to appreciate Mike's exhortation (its bluntness notwithstanding). It took me a long time to fully understand gliding flight, but since misery loves company, I was delighted to find that I wasn't alone. There are numerous misconceptions about optimum glide performance that prevail in even the most sophisticated quarters. Perhaps even more misunderstood are some of the techniques required to achieve it.

The normal, optimum, or maximum-range glide is simply a power-off descent during which the airplane flies a maximum forward distance over the ground from any given altitude. The ability of an airplane to do this is indicated by its glide ratio, a number that simply specifies how many feet forward an aircraft can glide for every foot of altitude lost.

For example, one of the world's highest performance sailplanes, the German Schleicher AS-W 12, has a glide ratio of 47 to 1; it can glide 47 feet forward during each foot of descent. To put it another way, from an altitude of one mile (5,280 feet), this exotic craft can glide 47 miles. Airplanes aren't quite that efficient.

To determine the glide ratio of a Cessna 150, for example, it is necessary only to divide the (air) distance flown in one minute by the altitude lost during the same time period. The Cessna 150 has an optimum glide speed of 70 mph which is equivalent to 1 1/6 miles (or 6,160 feet) per minute. Its sea level rate of descent at this airspeed is 725 fpm. Dividing 6,160 by 725 results in the 150's glide ratio of 8.5 to 1.

If the pilot of a 150 were faced with an engine failure while flying one mile (5,280 feet) agl, he could glide 8.5 miles in any direction, giving him a choice of landing sites anywhere within a 227-square-mile circle. But from twice the altitude (2 miles or 10,560 feet), the choice of landing areas is not doubled, it is *quadrupled*. From this altitude, the 150 has a 17-mile glide range and can touch down anywhere within a 908-square-mile circle. This certainly proves the adage that altitude is like money in the bank.

The optimum glide speed is usually found in the pilot's operating handbook and has much more significance than is generally appreciated. This is the *only* speed that results in the optimum, or maximum-range glide.

Some pilots, however, refute this. They claim that if an aircraft is low while on final approach, the glide can be "stretched" by raising the nose and reducing the sink rate. True, the rate of descent decreases, but so does the airspeed. It takes longer for the plane to get to the runway and more time is available for it to lose altitude. Glide performance suffers.

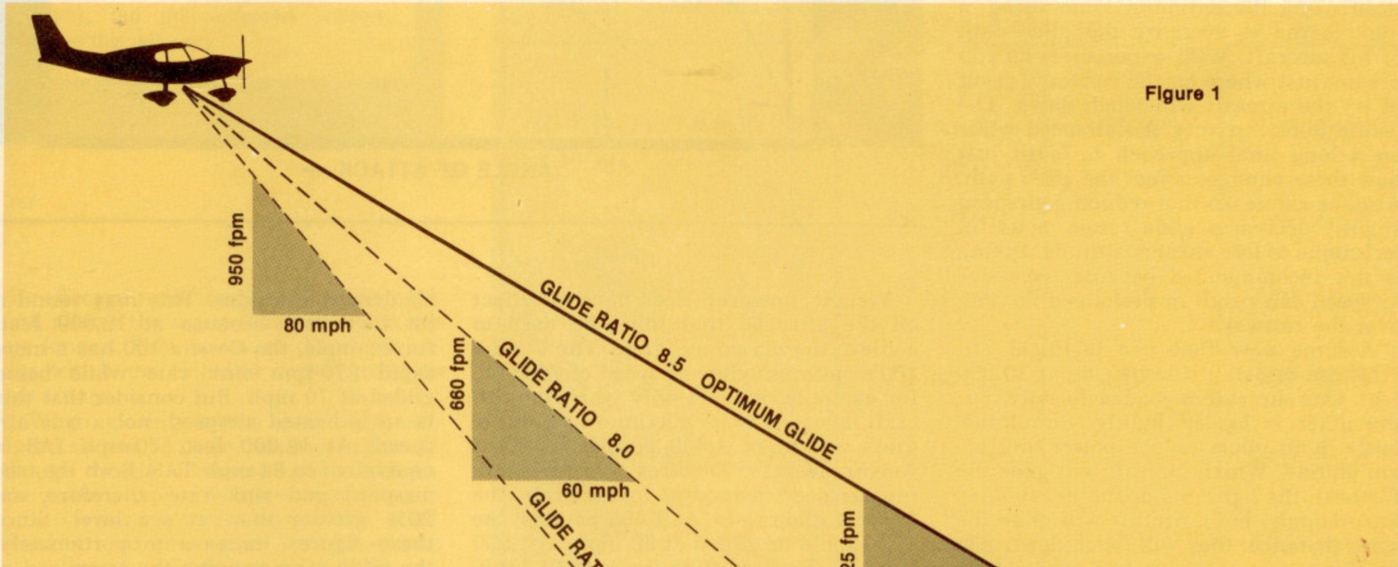
An example of this is shown in Figure 1. By reducing the airspeed of a Cessna 150 to 60 mph (one mile per minute), the rate of descent reduces to 660 fpm. The glide ratio at this airspeed, therefore, is 5,280 fpm (forward) divided by 660 fpm (downward), or 8:1, somewhat less than the 150's ability to glide at 8.5 to 1.

Other pilots insist that glide range can be extended by increasing airspeed, the theory being that this gets you to the runway sooner and the aircraft has less time to lose altitude. Not so.

If the 150 is flown at 80 mph (1 1/3 miles per minute, or 7,040 fpm), its rate of descent is 950 fpm. The glide ratio at this faster airspeed is, therefore, 7,040 divided by 950, or 7.4 to 1, a 13% reduction in glide performance.

It must be recognized that if flight at the optimum glide speed does not enable an aircraft to reach the runway, no amount of airspeed variation can help. There is no recourse other than to add power (if available) or choose a closer landing site.

Another hazard of attempting to stretch a glide at reduced airspeed is that this may place the aircraft dangerously close to a stall; low-altitude maneuvering is risky and less reserve airspeed is available to counter an unexpected wind shear. Also, there may be insufficient airspeed with which to flare. Consequently, the aircraft could simply mush into the ground at a high sink rate, a maneuver known to decrease the longevity of both landing gear and spinal column. (continued)



The urgent need to maintain a safe and efficient gliding airspeed, especially after engine failure, cannot be overemphasized. It is much preferable to fly into the trees while under control than to allow the aircraft to choose its own method of crash landing.

There is one glide-stretching technique that can be used as a last resort. If the engine is dead, really dead, with absolutely no hope of a restart (such as after fuel exhaustion), raise the nose and reduce airspeed (but only at safe altitude) until the propeller comes to a halt. A windmilling prop creates considerably more drag than one at rest and has a negative effect on glide performance.

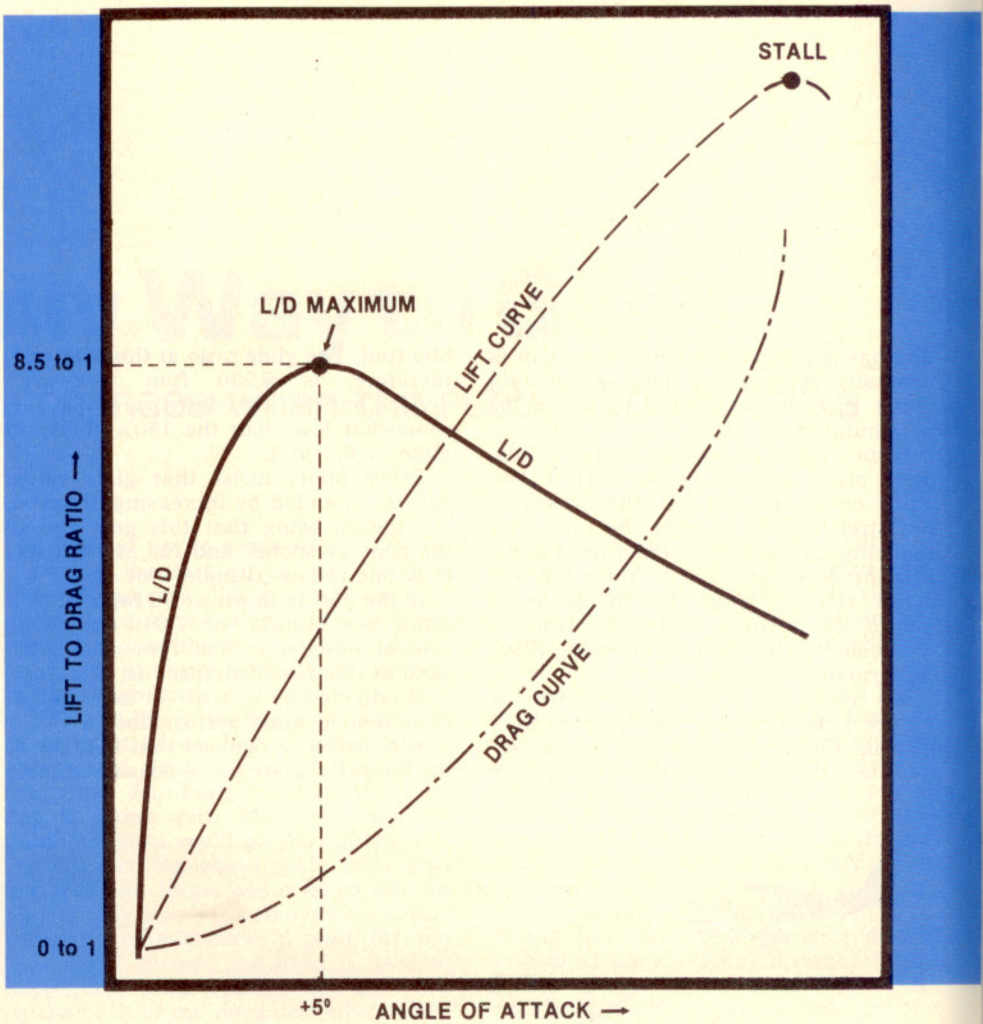
During tests conducted by Cessna, it was determined that stopping the prop of a Cessna 172 *increased* the glide ratio by 20%. A similar increase occurs in the Cessna 150 (and most other light aircraft) which boosts the glide ratio from 8.5 to 10.2, added gliding distance that could convert a potential disaster into a safe landing.

Once the prop is stopped, however, lower the nose and accelerate to the normal glide speed.

When power-off approaches are practiced using the optimum glide speed, a pilot learns to visualize the glide path of his aircraft. With experience, he can predict just where on the runway (or off of it) the aircraft will touch down. The astute pilot can vary the airspeed while on a long final approach to learn just how these changes affect the glide path. Also, he can learn that reducing airspeed slightly decreases glide range, a useful technique to lose surplus altitude. Diving is not recommended because excessive airspeed can result in prolonged floating over the runway.

Assume now that two identical aircraft are cruising side by side at 10,000 feet. One aircraft is loaded heavily, but the other is loaded lightly. Simultaneously, both pilots reduce power and begin gliding. Which aircraft will glide the farthest, the light one or the heavy one? Surprisingly, both aircraft will glide the same distance; they will touch down side by side.

The gliding characteristics of an airplane are determined strictly by its lift and drag *characteristics* (Figure 2). Since neither of these is affected by aircraft loading, weight has no effect on glide range or ratio.



Weight, however, does have an effect on the airspeed that must be used to achieve the maximum glide. The Cessna 150's optimum glide airspeed of 70 mph, for example, is valid only when the aircraft is loaded to its maximum allowable gross weight of 1,600 pounds. A gross weight decrease requires a corresponding airspeed reduction to maintain the 8.5 to 1 glide ratio. At 1,400 pounds, the 150 should be glided at 66 mph; at 1,200 pounds, the best glide speed is 61 mph. As a rule of thumb for most light aircraft, reduce glide speed 5% for each 10% decrease in gross weight.

Does altitude have an effect on glide performance? Absolutely none. The same indicated glide speed should be used at all density altitudes. This may sound a bit incredible because at 12,000 feet, for example, the Cessna 150 has a more rapid 870-fpm sink rate while being glided at 70 mph. But consider that this is an indicated airspeed, not a true airspeed. At 12,000 feet, 70-mph IAS is equivalent to 84 mph TAS. Both the true airspeed and sink rate, therefore, are 20% greater than at sea level. Since these figures increase proportionately, the glide ratio remains the same.

Does wind affect glide performance? Absolutely. Gliding with a tailwind obviously extends glide range; a headwind shortens it. To maximize the effect of a tailwind, an airplane should be glided somewhat slower than usual. This has

FIGURE 2

The graph shows how the lift and drag of a typical lightplane increase with angle of attack. The *ratio* of lift to drag (L/D) for any given angle of attack is shown by the heavily curved line. It is this characteristic of an airplane (or sailplane) that defines glide performance. As a matter of fact, the lift/drag ratio and the glide ratio of an aircraft are equal at any given angle of attack. Therefore, an airplane glides most efficiently when flown at that angle of attack where "L over D" is at a maximum which, in this case, is 5°. If the aircraft is glided at an angle of attack that is either smaller (faster airspeed) or larger (slower airspeed), both the L/D and glide ratio are reduced accordingly. This is why an airplane has only one optimum glide speed. When gross weight is either increased or decreased, the optimum glide still occurs at the same angle of attack (where L/D is at a maximum), but the airspeed required to achieve this will vary.

the effect of reducing the rate of descent, and allows the aircraft to remain in the air longer. This increases the time during which the tailwind can be used to advantage.

When gliding into a headwind, airspeed should be increased somewhat. Although the rate of descent also increases, the extra airspeed is necessary to maximize forward progress against the headwind. An extreme example is flying into a headwind equal in strength to the airspeed; the aircraft is motionless over the ground, yet it descends vertically at its normal sink rate. The glide ratio is zero. But if the airspeed is increased, at least some forward progress can be realized.

When gliding with a 10-, 20- or 30-mph tailwind, a reasonably valid rule of thumb suggests decreasing airspeed by 4, 6 or 8 mph, respectively. Against a headwind, increase airspeed by 50% of the headwind component. (Figure 3 is a more accurate example of how various winds affect the glide ratio of a Cessna 150.)

The effect of wind raises an interesting point. If a pilot is faced with an engine failure and a choice of two landing sites, he should favor gliding to the one downwind of his position (everything else being equal). Remember, tailwinds increase glide range; headwinds destroy it.

Although the normal glide is the most familiar, there is another type which can be equally important: the *minimum sink* glide. This is used when gliding range is not important, such as when flying directly over the landing area. At such a time, a pilot needs time more than anything else, time to attempt an engine restart or to simply gather his wits. By reducing to slightly above the minimum controllable airspeed, sink rate is substantially decreased. Contact with the ground is postponed. But be careful. When 1,000 feet agl (or higher), resume the optimum glide speed to increase maneuverability and to fly a reasonably normal glide path to touchdown.

The Cessna 150, for example, has a 725-fpm sink rate when flown at the normal glide speed of 70 mph. From an altitude of 10,000 feet, such a descent would last 14 minutes. But when airspeed is reduced to near 50 mph, the rate of descent is only 600 fpm. Such a glide from 10,000 feet would require 17 minutes. This increases glide *endurance* by three minutes. And three minutes to a pilot in distress can be of considerable value.

It is true that whatever goes up must come down, but *how* an airplane comes down is of prime importance to those inside. If it is without power, there are only two ways: accurately and with a plan of action, or sloppily and with a surprise ending. □

EFFECT OF WIND ON THE GLIDE RATIO OF A CESSNA 150 AT 5000 FT. MSL.

WIND CONDITION	BEST GLIDE SPEED (IAS)	GLIDE RATIO	RATE OF DESCENT
30 KNOT TAILWIND	64 mph	13.4	680 fpm
20 " "	65 mph	11.7	700 fpm
10 " "	67 mph	9.9	740 fpm
CALM	70 mph	8.5	780 fpm
10 KNOT HEADWIND	74 mph	7.1	850 fpm
20 " "	79 mph	6.1	900 fpm
30 " "	86 mph	5.2	990 fpm

FIGURE 3