Whoa There!

Ed: Over the years, brakes have been an ongoing discussion subject. Some folks feel their brakes are adequate and some do not. Some folks never have a gear strut over heating problem while others do. What makes the difference?

Our brake systems convert kinetic energy to heat energy. Once the brake system is "full of heat energy" it can absorb no more and brake action will fade to near nothing. Brake effectiveness will return after the brake system has dissipated the heat. If our brake system is inadequately sized for our aircraft and technique, we may lose brake effectiveness and directional control. If our system is too large, we carry more weight than needed and increase the risk of overheating the resin in the main gear strut. This softens the strut and may cause it to "fold up". It is difficult to move when the wheel's axle is perpendicular to the runway.

Sandi Schickel of Cleveland Aircraft Wheel and Brake Division, 800-272-5464 (1-800-BRAKING) <techhelp@parker.com>, gave me the FAR Part 23 formula for determining kinetic brake energy requirements for an airplane. KE = .0443 x W x V x V / N. KE = kinetic energy per wheel-brake assembly (ft-lbs), W = design landing weight (lbs), V = aircraft speed in knots, N = number of wheels with brakes. Assuming your brake system is in good condition and deceleration rate is limited to 10 ft/sec/sec the formula will indicate kinetic energy requirements for your airplane.

My O-235 Long-EZ weighs 825 pounds, lands at 60 knots and at the 1350 lb. gross weight generates a 107,649 ft lb. kinetic energy requirement. This is within the capability of the 117,500 ft lbs brakes specified in the plans. I have had only one case of nearly complete brake fade in 500+ hours. It occurred during a 65 knot rejected take off at 1425 pound gross weight and after a protracted cross wind taxi requiring brake action to hold the taxi way center line. The aborted take off alone required over 133,300 ft lbs of kinetic energy to be dissipated. The brake system could not absorb all that energy and faded to near nothing, an exciting time! Fortunately, the runway was long and I stopped before the end, in Watson Lake, British Columbia.

Most Long-EZs and Cozys weigh considerably more than 825 pounds. A 925 lb. EZ, at the above load conditions, generates 142,700 ft lb. of kinetic energy, a 1025 lb. one generates 152,000 ft lbs and an 1125 lb. one generates 163,700 ft lbs, all considerably beyond the original 117,500 ft lb. brakes. Extra weight makes a difference but we frequently do not do much about that if fuel/passenger/baggage demands. Within limits, we can control touch down speed, however.

An EZ landing at 1425 lbs at 60 kts generates 113,639 ft lbs energy. A 5 kt increase raises the level to 133,000 while a 70 kt touch down requires 154,600. I have seen a few hot dog pilots do 80 kt touchdowns and try to make the turnoff. That requires over 202,00 ft lbs of kinetic energy dissipation. **Speed makes a tremendous difference in energy requirements!** Touch down at minimum speed with minimum thrust!

Cleveland brakes are available in several kinetic energy ratings. The common ones appropriate to EZ type aircraft are; 117,500 ft lb. model # 199-102 or 199-103, 155,000 ft lb. (sometimes called heavy duty) model # 199-156 or the 192,000 ft lb. (sometimes called super heavy duty) model # 199-152 or 199-152A. If you want to melt the main gear strut and flatten your tires, try the 199-197 model rated at 289,000 ft lbs. Cleveland rates their brakes with standard 500 x 5 tires and have no data for Lamb size. They go for a deceleration rate of 10' per sec/sec.

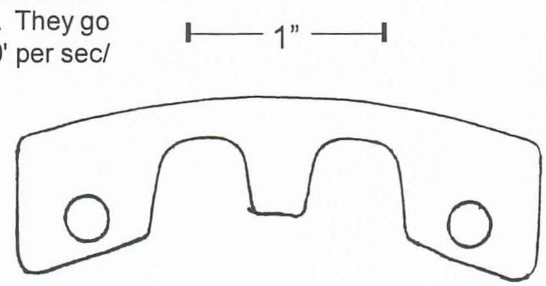
I am sure there are other differences, but essentially the 117,500 system can be upgraded to the 155,000 capacity by changing to 3/8" thick brake discs (3.5 lb. total weight increase for the airplane) and adding a spacer to allow for the increased disc thickness. Kit #199-93A (list price $298) will do it or buy the replacement discs and saw your own 3/16" thick spacer for about a third of that. See spacer drawing below.

Upgrading to the 192,000 system requires different calipers with a larger piston. The smaller system pistons are 1.5" in diameter and the larger is about 2" diameter. 3/8" Disc # 164-99 is still used while the new caliper is # 30-133.

If you don't want to spend the extra money, carry the extra weight and risk overheating the strut, just reduce energy requirements. Land at minimum speed, decelerate slowly, use maximum aerodynamic braking (rudders and landing brake deployed and roll long), set engine idle speed at minimum (there is considerable thrust at 1000 RPM. Consider installing electronic ignition as it allows significant reduction below mag ignition idle speeds.) and increase brake disc cooling (see CSA April 99 p 32).

Reduce taxi related heat that robs brake system capacity. Do not taxi while dragging the brakes. Taxi on the side of a crowned taxiway to reduce braking needed to compensate for cross wind. Have the nose wheel shimmy damper set correctly so that excessive brake application is not required to steer.

Of course, if all else fails, just raise the nose gear. It is an effective emergency brake. Just ask any of us who have "tested" that technique. Caution - do not stick your hand in the resultant spinning crank.



pattern for 3/16" spacer