

The Basics of Brakes

Ann McMahon (LA) - Brakes on the Long-EZ are a very important but somewhat unpredictable system, which provides both steering and stopping. They are unpredictable since we cannot check them until we land and apply them. Certain maintenance problems can lead to erratic operation - fine one day, gone the next. A recent experience of losing all the right side brake fluid, provided me an excuse to overhaul my entire brake system and learn all I could. As a novice and non-builder, I will probably never know as much as Gene Zabler, Herb Sanders and Vance Atkinson have forgotten, but you have to start somewhere.

You non-builders know many A&P's are unfamiliar with the Long-EZ and will not take responsibility for the airframe inspection unless you do. To take this responsibility, you have to learn about your aircraft. I hope this article helps.

Research took me to back issues of Central States Newsletters all the way to 1987, the Arnie Ash years (Central States founder) and my own set of Long-EZ plans. I also received valuable input from Gene Zabler, Miss Sandi at Cleveland Wheel and Brake and the Cleveland Brakes Maintenance Manual. Most importantly, I learned a great deal from slowly taking the systems apart on my own Long-EZ with the thoughtful and patient assistance of my husband, Rhett.

Preflight This is probably the most important check on the brake system since the first sign of trouble will usually reveal itself in a thorough exam of the wheels, brakes and connections. These are the items on my preflight list.

1. Check for dark residue on brake assembly that means slow leak.

2. Check for the obvious fast leak with fluid on the ground or parts.

3. Check tightness of line connection at brake assembly.

4. Check connection points of aluminum lines for fatigue cracks.

5. Check pad thickness.

6. If you have exposed portions of Nylaflo, make sure aluminum tape wrap is secure and covers all these areas to protect from UV.

7. As you taxi to the runway, concentrate on how the pedals feel. Are they firm or do they feel spongy and tend to travel a bit after full application? Do you have vibration?

8. At run-up, notice how the brakes hold. Are they steady or do they creep?

Regular Maintenance - Check the lines throughout the aircraft annually.

There is ongoing debate between aluminum lines versus Nylaflo lines. They both have their strengths and weaknesses. Aluminum lines are light and strong. However, they are *not* supple. I just saw a fatigue crack in front of a connection on an aluminum oil line in my hanger mate's Lancair that nearly cost him his engine. Nylaflo lines are supple and they are strong. As a knowledgeable friend said once, "you could hang yourself from the ceiling with them". However, they are susceptible to UV light and to becoming brittle. So they must be replaced at intervals. Best consensus seems to be 5 to 7 years interval. If you are doing regular and thorough maintenance checks, this should come as no surprise.

Overhaul those master cylinders and wheel cylinders approximately every 2 years. Your overhaul schedule may be different. Cleveland can provide exploded views to aid cylinder reassembly and identify parts.

Master cylinders collect dirt. They do this because the piston in the master cylinder travels only a short portion of the available stroke - just far enough to expand the caliper and then return it to its relaxed position. Dirt accumulates in that unused part that never sees the piston. Therefore, never pump up the system by depressing the master cylinder its full length or until it bottoms. If you do, you pull this dirt and grit up in the cylinders damaging primary cups and/or O-rings and causing complete failure of the master cylinder!

O-rings have to be replaced anytime the assemblies are taken apart because brake fluid makes the O-rings swell. After removal, they do not fit properly and need to be replaced. Cleaning is also important as you can not detect leaks with a dirty assembly. If you have Cleveland brakes, you will have to remove the wheel cylinder's piston to replace the O-ring. This can be done by holding a hand tire pump to the line connection and gently applying pressure. The piston will pop out.

Failures can seem unpredictable in how they occur. The brakes can work fine at one temperature and then dump all fluid when it gets cold, for example. Note the position of the clevis rod on the piston rod *before* you take the master cylinder apart. This is your brake/rudder adjustment on the Long-EZ (more on this later). It would also be helpful to check the rudder deflection before you start this process.

Replace hardware at line connection points to brakes and master cylinders approximately every 2 years. Remember, your own schedule may vary. My experience is with Nylaflo line hardware. Replacement parts are not standard to certified aircraft maintenance and unique to the homebuilt arena. This consists of a 3 part, brass fitting which can be purchased at your local automotive or hardware store. Included is a sleeve with a flanged end that fits inside the last half inch of tubing at the wheel end, a short barrel shaped sleeve that fits over the outside of the line and a nut that fits over both. The barrel sleeve and the nut both slide to the end of the tubing where it connects. The nut is then slowly tightened over the barrel sleeve, crushing the barrel sleeve over the tubing and inner sleeve connection to make a leak-proof fitting.

Replace brake pads as needed or anytime there has been fluid leak. Brake fluid destroys the integrity of brake pads. They disintegrate. My experience has been that original equipment manufacture's pads work the best. Make sure to order extra

rivets. Purchase the proper tool to remove and replace the brake pad rivets.. I have the threaded driver and it works just great.

Once the system is back together, you will need to condition the new pads to achieve max surface life. For Cleveland's, this means taxing the aircraft at 1700 rpm for 1500 feet with both brakes applied to keep the plane running at 5 to 10 mph. Allow the brakes to cool for 10 to 15 minutes and then see if they hold the full run-up rpm. If not, repeat the above procedure.

Replace the fluid in the brake lines with every overhaul. The correct way to do this is to push the fluid via an apparatus attached externally to the bleeder valve on the wheel cylinder or caliper. If you do not have a specific air tool for this, a hand operated oil can with a piece of tubing on the end of its snout works just fine. If you have nothing, you can pump the brake pedal by hand, using lots of short strokes to avoid bottoming out the piston discussed earlier.

Make sure your aircraft is parked with the nose gear fully extended before you start this procedure or you will probably not eliminate all the air bubbles from the system nor fill the brake master cylinders fully. The master cylinders must be at the high point of the system to get all the air out of the lines. This really takes two people if your master cylinders are mounted in the front, as mine are. One person needs to make sure all air bubbles are out of the lines while the other pumps fluid at the wheels. Aviation brake fluid still seems to be the best. Keep in mind it is flammable and there have been brake fires started with the combination of a leak and hot brakes.

Adjust the clevis rod on the cylinder piston rod, if needed. This adjustment affects both the brake pedal portion of travel of the rudder pedals and the rudder deflection itself. Start at the point your marked on the rod before taking apart the master cylinders. My Long-EZ's rudder pedals traveled too far before engaging the

brakes. In screwing the clevis rod up or down on the threaded portion of the master cylinder piston rod, a position was found that provided firm braking with more than the minimal rudder deflection. Make sure you know where the threads stop at the top of the rod because you can not see them when the clevis rod is in place. Also remember, as the brake pads wear down, the rudders will deflect more.

In the original plans, Burt Rutan calls for a 30-degree deflection of the original rudders. I have the big rudder mods on my Long, that call for 23-degrees to 28-degree deflection. Some Long drivers, however, prefer to crank in a lot more. Be careful you do not adjust the rudder pedal travel so short that the brakes lock before you get the deployment of rudder you need on a very windy day. You will have to do taxi runs to check this.

Additional Information is available. Get the Cleveland Maintenance Manual and sign up for their periodic product updates. You can reach Sandi at 440-937-1261. They will answer the phone "Parker-Hannifin" because Parker owns Cleveland. Sandi can also provide exploded, labeled views of the assemblies.

Jeppesen provides excellent basic maintenance instruction books on wheels and brakes. You can buy these from most of the Long-EZ construction supply sources. There are also maintenance videos available from the same place and there is an especially large selection in the Sporty's catalog.

This Central States newsletter has a wealth of information if you dig. If you don't like digging, contact David Orr at 714-852-7230. He can generate computer printouts of articles on any topic you request for a nickel a page (last check).

Finally, talk to as many Long-EZ drivers as you can and take time to learn your own airplane.

Here's to safe flying.

ANR Headset Conversion Kit

Jim Madsen - (MI) During years of enjoying my Long-EZ I have had one complaint **NOISE!** With only a 100 hp engine, I tend to run at high power settings. As a result, my ears would ring for as much as a day after a flight.

Every summer at OSH I would lust after a set of Bose dynamic noise canceling headsets, but the price tag never fit into my budget.

I recently purchased a \$169 ANR kit to convert my David Clark's to something resembling the high priced Bose from Headsets, Inc 2320 Lakeview Drive, Amarillo, TX 79109, Phone 806-358-6336, FAX 358-6449, e-mail: anrsets@aol.com. For an extra \$50 they offered to install, but since I built the airplane I figured I could rewire something as simple as a headset.

Instructions claim any competent electronics technician should be able to install it in less than 2 hours. The disclaimer about requiring "reasonable skill in the use of a soldering tool & a minimal understanding of electronics" is nothing more than the typical legal boilerplate. Well folks they made their point. It took me an entire evening to install the kit. The instructions were easy to understand but this is not the time to learn fine wire and circuit board solder skills. I felt fortunate I did not messed it up.

Instructions strongly recommend the use of gel type ear seals, \$18 from Aircraft Spruce. The gel seals are more comfortable on long trips. The dynamic noise canceling function is powered by a standard 9V battery with supposed life of 20 hours. My first battery lasted over 15 hours, until I accidentally left it on.

The headset works great! I can't tell how many decibels of noise reduction I experience, but it is significant, especially in the low frequencies. I no longer have any ringing in my ears, including a recent trip with a couple 4 hour legs. I highly recommend noise canceling headsets to all my flying friends and the ANR kits to those who can not afford the high priced spread.