***-Brake Lines:***

-Marc Zeitlin Jan 2012: [Rock Broad build: From (landing gear bulkheads) down to the brake calipers I plan to use "-3" Teflon lined braided steel tubing.] Good on you for the "-3" SS Teflon tubing. Use 5052 AL or SS for the other lines, with braided teflon lines to the MC's (since they move) and never worry about brake lines again. Point me to a car MFG that uses nylon tubing for brakes... This would be a mandatory change I would make to the COZY plans.

-Marc Zeitlin Jan 2012: Q: Flexing of the gear leg--will that affect the AL lines over time? Ans: Yes, it would, which is why no one has suggested using hard AL or SS lines down the gear leg (although some do so - like Cessna). All the suggestions/recommendations here resulting from Rock Braud's questions  
have involved using hard lines only where there is no movement, and using SS/Teflon hose anywhere there is movement.

-Dale Martin [**http://www.long-ez.com**](http://www.long-ez.com) Jan 2012: ...for those that think about longevity (service life), safety and ease of maintenance: We have 3 to 4 choices for brake lines; Nylon, Braided flexible line, aluminum, & stainless steel. If your concerned about weight at all the full run of flex is not an option but I have worked on planes that have it installed. Nylon does work for a while then there is that day it fails and could possibly cost thousands and a bunch of time (or your life). Aluminum has its place but because this is a system that can contain water (well, you get the corrosion picture) and if anything ever get push against it can crush easily severely limiting or stopping flow. Then there is stainless steel which only drawback is initial cost.  (SS) is a very solid material with a great history. If your building this plane to be safe, last a long time, or even want to make it easy to maintain, is there any reason not to use stainless steel tubing?   (For) those who would like to use flex where it connects to the master cylinders and calipers, we have a source that is lightweight and works very well.

-Marc Zeitlin Jan 2012: (I ran) hard AL lines from the nose, near the MC's, to the parking brake (near  
the IP) to the front LG bulkhead fitting. From the LG bulkhead to the calipers is flex and from the hard line in the nose to the MC's is flex and from the MC's to the reservoirs is flex. Anything that moves, in my plane, has flex lines to it. ...some folks have (flexible lines the last 12-15") connecting nylon lines to SS/teflon flex lines for heat protection near the calipers.

-Dave Froble Jan 2012: one solution is to make a 360 degree loop in the line near the wheel caliper to take up any motion. There (can be) problems with connections, and there (can be) problems if you do not put a small length of flexible line where there can be movement.

-Marc Zeitlin Jan 2012: (Cesnas, Pipers and other metal aircraft) do not use fiberglass struts that are  
extremely flexible, being able to bend far enough to put a wheel imprint in the bottom of a wing without breaking (obviously an extreme instance).....my point is that they flex more than Cessna metal struts, and that Piper (and other oleo type gear MFG's) might have hard lines down the gear leg that doesn't move, but they have a flex line to the caliper from the non-moving bits.

-Larry King Jan 2012: >40 feet of 1/8" x .020 wall 304 Seamless tube $2.03 / Ft  
>4 pieces of 1/8" compression x 1/8" male NPT 90 degree elbow $8.80 each  
>2 pieces of 1/8" compression union $8.24 each  
>The total will be $132.88 plus UPS charges.  
>Kelley Greene  
>PAC Stainless Ltd  
>Ph: 206-824-7780  
>Fax: 206-878-2475  
>www.pacstainless.com

-Chuck Busch Jan 2012: In about 1984 I moved the master cylinders up front and replaced the tubing to the calipers--(can't) remember if it was nylaflow or nyloseal - but (whatever the plans called out). After installing ...brakes seemed a little spongy.  ...resident guru, Al Coha, suggested a *smaller (nylaflow?) tube inside my existing tubes (to) help prevent the pressure from ballooning the larger tubing*.  If I remember correctly the OD of the inserted tubing was 1/16".  The pedals felt much better.  A side effect was a little slower release of the caliper due to the smaller inner diameter of the tube, but no big deal. As more hours accumulated on the plane a constant maintenance issue was leaking at the junction where the nylaflow connects to the brake caliper.  My sense of the problem was ... heat of the caliper causing degradation of the tube to caliper connection.  (~)1986, Harry Abbott (I think it was Harry) ...*idea to replace the nylaflow from the exit point on the gear leg to the caliper with steel tubing.*  He had this on his Long.  ...after visiting NAPA, I installed the same setup and serpentined the tubing along the inside of the axle-caliper area to provide heat dissipation.  Additionally the steel tubing was clamped off to one of the axle bolts to provide stability of the steel to nylaflow union, and to provide a heat sink for the steel tubing.  (After switching) engines to the 320 from the 235 (and) now tipping the scales at 970# from 832#.  I installed the HD Cleveland calipers and disks. From 1990 to 1995 I commuted from San Diego to Fullerton every work day with moderate to hard braking required at KFUL.  (From IFR approaches) braking was usually hard, very sometimes very hard.  (Substantial) sets of tires and brake pads consumed ...now have ~2400 hours on the airplane with the installation as noted above being totally trouble free.  We have backfitted the steel to nylaflow on two other Longs here at KSEE with similar performance.

-Marc Zeitlin Jan 2012: Although I have AL hard lines in my aircraft and have flexible SS/Teflon lines anywhere there's relative motion, I agree with Dale that SS hard lines are the safest possible lines to use - far better than the plastic lines, and more resistant to fatigue and impact damage even than AL lines. Dale even uses SS hard lines down the gear legs, to flex lines to the calipers, and has had good experiences. I would NOT run AL hard lines down the gear leg for fatigue reasons, but apparently the smaller diameter SS lines (and SS has different fatigue limits than AL) works well for that purpose. Dale and I agree that SS/Teflon flex lines are required anywhere substantial local motion occurs. Now, I believe that AL hard lines are acceptable (although not the best) as their level of safety is not far below the SS hard lines and are still way better than the plastic lines (IMO). I installed AL lines because I was familiar with the technology, it was relatively inexpensive, and is way better than the Nylaflow that I previously had. If you are comfortable using SS lines with Swagelok or other appropriate fittings, you cannot go wrong and will have the safest possible brake line system.

-Jim Evans Jan 2012: Concerning SS lines.  If you purchase from Swagelok, you might consider the annealed SS which is softer and can stand up to bending.  Check the specs. out for yourselves at Swagelok's web site.  They can give you all the specs. needed to answer your questions.  The 1/8" SS comes in 20' lengths but if you get the soft SS it can be rolled into a coil for shipping.

Izzy Briggs Jan 2012: It's my understanding that both Al and SS need to be supported every "X" number of inches/cm. I was not able to find the documentation...

Marc Zeitlin Jan 2012 Reply: I looked in AC43-13B and strangely, this isn't covered. ...But there IS an FAA publication in which this information can be found, and which has a lot of good info on hydraulic line tubing and flex hoses. See FAA document 8083-30, the Aircraft Maintenance Technician Handbook: <http://www.faa.gov/library/manuals/aircraft/amt_handbook/> Chapter 7 "Fluid Lines and Fittings. Last page, 7-22, table 7-5 is what you're looking for. 1/8" tubing in steel has a maximum support distance of 11.5". I was going to recommend (in light of no documentation) 8" - 12" max, so that would have been a pretty good guess. I'd go with 9" for conservativism and call it a day.

From: Bulent Aliev <bulent.enginegear@gmail.com>

...Just in case you decide to install braided Teflon hose end at the calipers, this is a good place for pre-made hoses: http://www.racerpartswholesale.com/product/11150/AeroquipBrakelines3 And this one for fittings; http://www.jdaent.com/performance-hoses.html

Bulent "Buly" Aliev, Cozy Mk-IV N484BD, KPMP Pompano Beach, Florida USA, http://tinyurl.com/2dl88bz

August Discussion:

From: ARGOLDMAN@aol.com

To: canard-aviators@yahoogroups.com

....personally don't know why nyloflow was ever used... seems to be working on most of the planes ...If you are going to plastic, nyloseal is a much better choice. Some are using aluminum tubing, some stainless steel. ... caution you against using any plastic material all the way to the calipers as heat, both radiated, that's why we have the shields, .... nyloseal part of the way down the leg and the last part, not protected by the shield,

!!!!!The last part is, of course protected by the shield. the plastic should not be used where it is not protected. look at the disk and draw a line from the lowest part through the top of the shield to see the affected area.!!!!

IMNSHO should be flexible hose ie teflon with appropriate fittings -3 should be fine. ...flexible hose enables you to service the brakes more easily and reacts minimally to the normal operating temperatures.

You might find it preferable to use 1/8" Nyloseal ... high pressure variant. Do not use inserts ... Make sure ... fittings are totally compatible with nyloseal-- ... from the manufacturers of the nyloseal, not from the fitting people. Standard compression fittings use a little barrel shaped insert which compresses around the tube. So far, so good. ...believe most of the fittings will be 1/8" NPT. Make sure that there is a little slack (curve) to your final tube (steel/teflon as suggested before) to allow removal of the caliper for servicing the linings without breaking the integrity of the fluid part necessitating rebleeding.

Ken <kenezmiller@optonline.net>

...replace tubing, I would go to 1/8 seamless stainless and stainless Swagelok type fittings. You can get all that from McMaster-Carr. It will slide inside the existing tubing if it is glassed to the strut. I have simply replaced the line from the caliper to the hellhole, then continued with NylaFlow up to the masters.

James Redmon <berkut13@berkut13.com>

...and as a reminder if you do this - use the .020” thick wall 1/8” SS tube. Thicker wall tube will decrease the ID of the tubing such that brake operation will suffer.

Ken Miller:

...replace tubing, I would go to 1/8 seamless stainless and stainless Swagelok type fittings. You can get all that from McMaster-Carr. It will slide inside the existing tubing if it is glassed to the strut. I have simply replaced the line from the caliper to the hellhole, then continued with NylaFlow up to the masters. The real solution is to remove the Clevelands and install Grove 57-224’s or heavier. ...

Ken

From: Keith Spreuer <keith@airstarts.com>

... No solid SS is recommended inside the fuselage. It is actually smaller (OD) than 3/16 Nylaseal. The braided is very much recommended near the caliper and desirable at the MC.

From: Alek Jadkowski <mr.jadkowski@gmail.com>

... found out that Earl's Performance makes an AN-2 braided line, ...

Alek