

Brake installations to consider on a Trigear Conversion For internal use at Custom Flight Creations By Bud Yerly

It is imperative that all controls are full proof. Obviously, failure of any steering, suspension, brake or flight control is going to be very dangerous at a minimum, and catastrophic as a rule. I have found that the brake line and fittings suggested below will work well in any experimental aircraft.

Most aircraft manufacturers use reliable components such as those from Grove, Cleveland and Matco Manufacturing. Of all the manufacturers, Matco has the most complete brake design instructions and well tested brake master handle and foot pedal designs for experimental builders to consider. Matco supplies all the cylinders, brake lines, and fittings one would need for design and construction of the lines from the master cylinder to the slave or caliper.

Refer to Matcomfg.com for the proper lines and fittings for the brakes. I always use the brass brake fittings that have the sleeve for the inner tube molded to the fitting for a snug fit of the line outer and inner diameters, and the cap nut that compresses the line is snug also as shown below.



Some experimental builders use SAE type fittings (like a water fitting for a fridge) and they are OK, but require an inner tube support fitting, and the brass compression is designed for copper tubing but works OK on the Nylaflo II line. If it is not tightened properly they will pop under pressure, but in their defense, all compression fittings if not tightened until firm and then one flat minimum more will pop. That said, the SAE fittings are deceiving as they feel snug, but the nylaflo tubing will compress a bit in diameter, but still leak, so they need a bit more snugging down. Don't overtighten as the line will be crushed and will leak.



05-12256

05-12257

Above is a typical SAE fitting.



2030-4

Typical SAE compression components are pictured above.

Note:

Remember, these SAE fittings are not designed for high performance braking. Refer to the brake manufacturers recommendations for fluids, fittings, brake lines and valves.

As for the brake line, the high pressure Nylon II type line is all I use, which is 2000 to 2500 psi. If you must have a more flexible line, use the 1/16 inch ID line (1/8 inch OD) and fittings Matco supplies. They work really great, but you must change out all the fittings in your cockpit module. Don't fall into the discussion that flow will be too low in an 1/16 inch ID/ 1/8 inch OD line as there is no flow in a brake system, just pressure. Another reason to consider using the 1/8 inch line is it will move an air bubble out quickly when bleeding.



Although Nylaflo II in either black or natural clear will work, you have to use the proper pressure wall thickness and fittings which are SAE or DOT type. I just don't like the SAE because if improperly tightened they pop off.

Here is the combination from Aircraft Spruce to look at:

NSR Tubing - Natural05-12488	1/4	.050	2120	9/16	.015	\$1.03
69SM-04 X 02 - Male Elbow 1/4"	1/8"	05-12260				\$4.90

However, the almost full proof Matco combination is as follows and can be ordered from Matco Mfg and A/C Spruce also:

Brake line: Nylon II Tube .25 06-01133 MSCNNR4/035
Or directly from Matco p/n: MSCNNR4/035 TUBE; NYLON II .25

Brake fittings such as this elbow:

Brass Elbow, 90° 1/8" NPT - 1/4" Compression 06-01139 MCS269P

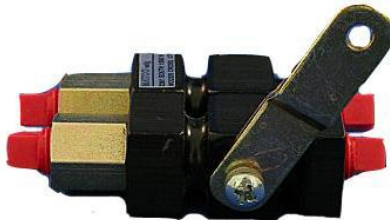
Again, a very good line to consider which has excellent bending and bubble pushing is 1/8 OD line available at Matcomfg.com, which must use the 1/8 fittings Matco sells: MSC169P BRASS ELBOW; 90 DEGR for 1/8 tubing and the tubing is MSCNNR2/026 TUBE; NYLON 0.125

You may also want to invest in the park brake valve. In a Europa conventional or Trigear you run out of hands very quickly without it during ground checks. This is a very good valve, but without proper care and fluid can leak. Pay attention to the handle movement requirements.

Warning:

The installation shown by Europa can cause inadvertent park brake actuation as there is no positive on off locking mechanism. As a minimum, a guard bracket should be fixed to either side of the handle and knob to prevent your arm from actuating the brake inadvertently.

PVPV-D PARKING BRAKE VALVE, DUAL shown below:



Bleeding:

My feeling on bleeding, is never break a line to bleed a bubble. The Jamar brake is miserable for some to bleed as they don't understand how it is designed, so see my techniques on how to bleed them go to www.customflightcreations.com and go to the Techniques tab for instructions. If you have properly designed the brake holder assemblies and their mounts, have thought ahead and have used nut plates or T nuts in your structure to make the Jamar or any other brake master cylinder easy to remove, maintain and bleed, it will serve you well.

Here are a couple of installations to consider.

If you have the Kart Kraft brake masters which have no reservoir one can fabricate a bracket or cut and reuse the Trigear mounts provided by Europa.

Kart Kraft Brakes installed as hand brakes:



These brakes are easy to make but must be leveled and filled when the pads wear, or you have spongy brakes as there is no reservoir to compensate for pad wear. No reservoir also means a small leak leaves no brakes at all. The manufacture is cheap and normally a 9-10 inch handle from lower pivot to top knob gives good pressure and are easy to pull for normal operations.

A parking brake works with these master cylinders. Don't forget to make a hole in the top of the cockpit module to service them or drop them out of the bottom as shown above... The brakes were designed for British fittings and lines which don't fit the US Matco fittings exactly. Make your fittings all US or all British to save you future maintenance issues.

Kart Kraft brake handles shown installed in 12AY originally.



The Kart brake handles are 1.5 inches apart so space is limited and putting knobs on must be planned. The small tab at bottom aft and below the brake slot is the access for fluid servicing. However, I have found that getting the bubble out of the master still requires loosening the brakes master and rotating it forward to level to get the master topped off absolutely full to the top. It is messy also, as Mil 5606 or the Dot fluids stain the interior.

Any air bubble left in the master just stays there and makes for a bit of a spongy feel. This install requires the decorative top trim cover to come off to allow access to the four screws holding the brakes to the cockpit module on this plane. The screw holes have aluminum plate between the glass plies for additional strength. Normal inspection/major servicing is accomplished by dropping the brakes out of the bottom access hole to inspect and service.

I found I could no longer live with the one shot Kart Kraft brake master cylinders any more. I decided to go to the Matco MC-4 master cylinders and needed to make a mount that would do double duty for both under side mounting of the cockpit module, or on a platform mount such as Europa has designed.

For those with only a belly access hole (as in a mono conversion) a plate is installed in the top and secured with AN3 screws into metal reinforced strips in the console top. I like this method of mounting as it makes a simple unscrew of the support, let the brakes drop down and the instrument panel removes quite easily for upgrades. If an access hole is made in the top of the panel, I use my Jamar style brake support C section bracket. My mount simply bolts to the flat top with AN hardware and nut plates.

Remember, that brakes need to be serviced in the future and it is imperative that they be removable or serviceable. The rule is: “If you make it serviceable, it won’t break or need servicing, but if you don’t, I guarantee it will fail or need periodic service.”

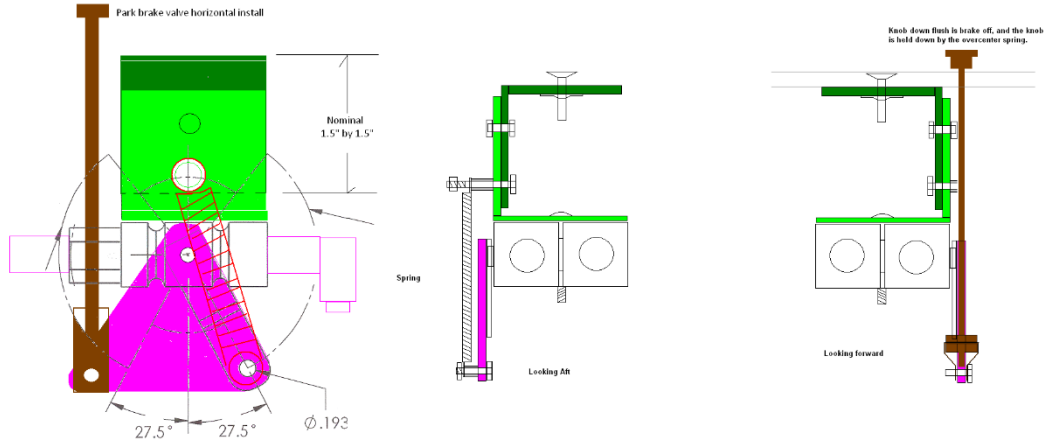
Pictured below is the mount I fabricate for either top or bottom installation with the Matco MFG MC-4 masters for use in 12AY:



This is a design that does not include an integral park brake to fit between the handles or near them. I like a separate location for the parking brake valve, but we have fabricated an all in one holder out of sheet metal, angles etc. for those who must have the brakes as a unit. A bit of a Rube Goldberg project: “Never make anything simple if it can be made complex and wonderful”.

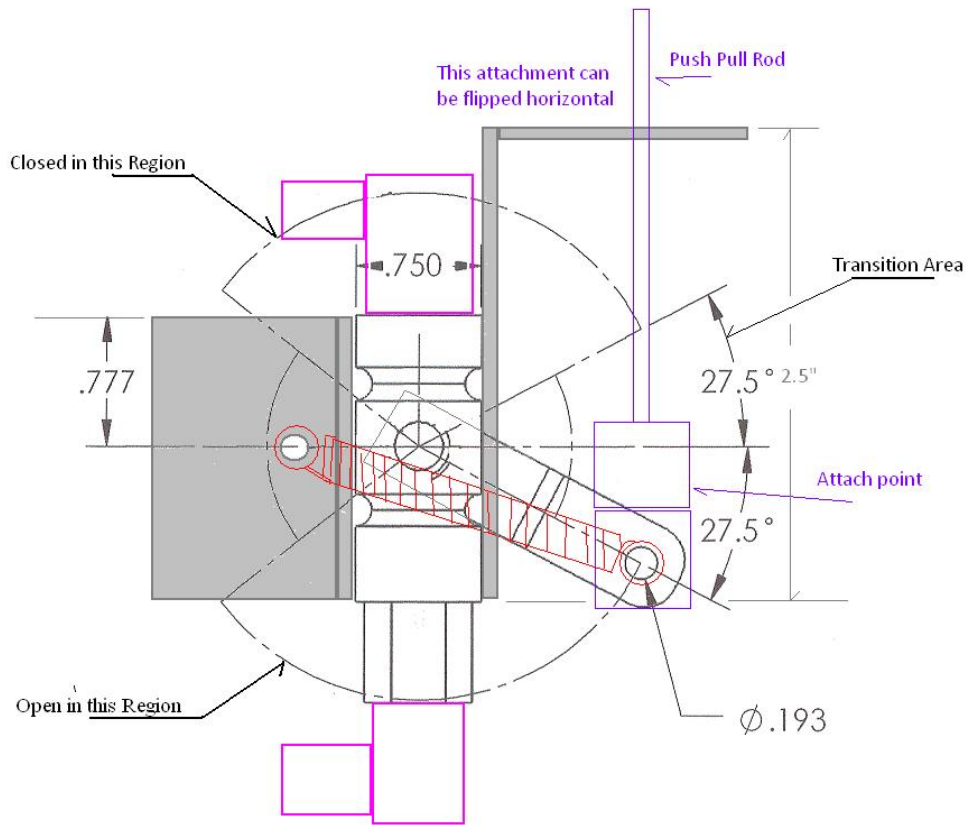
Caution: Always use AN hardware, locknuts and or pins with cotter pins for brake fitting security. Brakes are used for steering and stopping, any failure and you will loose both.

Shown on the next page is an alternative park brake installation using a push pull rod. It is a fairly simple support bracket to make but a bit of laptop machining is required to get the handle attachment just so. This works flawlessly and the entire system can be mounted on a single piece of aluminum or wood mount quite solidly. The push pull rod has a red soda straw around the threaded rod to be a visible reminder that the park brake is on (up position) as the spring holds the brake rod in both the up and down position via an over center spring. The down and up stops are a stop nut affair on the rod.



To install brake valve in horizontal position it is recommended a triangular shaped part be attached to the provided arm and attach the vertical pull rod to the third leg as shown to allow a spring and the rod to work with the proper valve angles.

Matco Park Brake Install Vertical Push Pull Activation Rod Typical



Shown below is a mockup of a Matco set of cylinders with the park brake sticking up from underneath with a push pull positive release and spring loaded up and down position park brake.

Note that this is in mockup stage. It is actually attached to the standard C mount I glass into the passenger side of the cockpit wall with nut plates to allow complete removal for inspection and overhaul as necessary.



Below is the Matco installation using a detachable panel in the top of the cockpit module showing the C panel glassed to the module side.



Note the clecos are temporarily holding the fixture until the nutplates are installed. This person cut out way too much tunnel top off and much reinforcing was required to make the center tunnel structurally sound. There are cross braces, thick flanges and a structural top plate now to allow me to sleep at night. The brake mount however is very strong, and will survive up to 600 pounds of pull without any deflection. I ran out of pull capability before it ran out of structural strength. I wouldn't lift a fully loaded Europa from it but just the fuselage, empty of fuel I would if it were on the centerline. It is strong and light.

Shown below is the Dual Jamar Steering brake as normally ordered. The handles are way too long as these are steering brakes for drifting cars. The handles only need to be 9 inches long for maximum braking ability in an aircraft...





Here is a nearly finished Jamar installation. Again the whole cockpit module is reinforced and a flange made to install the top cover. The Jamar brake cylinder is secured with Allen head tapered bolts for a nice fit and finish. Use a magnetized Allen wrench and you don't drop the crews into the dark hole underneath.

This setup requires removal of the master cylinder to service the brakes so access holes and proper nut plating is required to make instrument panel and brakes service reasonably easy. Note the brake lines are clear type to be able to see the bubbles easily and are routed down out of necessity to the wheels to keep any bubbles flowing up hill all the way. However, once the bubbles get to the Jamar master, you have to roll the master on its side to purge the bubble from the piston cylinder to the central reservoir. Hence the need to keep these brakes easy to service.

Caution: The threaded bolts holding the handles in a Jamar master must use Loctite to keep them secure at a minimum, as they will loosen over time and fall out. If Loctite is not preferred, safety wire the screws to prevent them from falling out.

Here is what the final center tunnel setup looks like with the cover installed over the hole. Cover is structural fiberglass covered with leather.



Note:

In any of the Trigear or conventional gear installations, the center tunnel has to be modified for access from the top or bottom or both for proper inspection, bleeding or repair. This is especially important for the Jamar brake, as it must be removed from its mount and rolled on its side for proper bleeding. Note that the handles and instrument panel are removed in this aircraft for a glider wing conversion.

I later made a mount for the Matco MC-4 master cylinders as stated above, for those who would like to swap out their hard to bleed Jamar brake master for a fairly easy to bleed Matco system.

No matter what you decide to do with your brakes, make sure the brake system is easy to maintain from the master down to the caliper. Every 25 or so hours I pull my bottom panel in the tunnel and inspect for leaks, I flip up my wheel pants and inspect my disk, caliper and pads. As a result of these mods, it has made our aircraft easier to troubleshoot and maintain.