

How to Build a Fuel Line

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Rev. G 4-19-05

Colorado Corvette Craziest (CCC)

The Ultimate Corvette Tuning & Beer Drinking Fraternity - Lafayette, CO

Photos & photo editing by Jeff Todd, owner of the '66 427 Corvette Roadster featured in this article - Arvada, CO

Special Formatting and File reduction by Karl Stutsman, Member – CorvetteForum.Com

This tech paper will discuss basic techniques for building a steel fuel line for the pressure side of a carbureted fuel system. These techniques can be used for both restoration/reproduction lines and for custom fuel lines.

The procedure outlined here is based on my years of experience doing this work in the quickest, least painful, most economical way while producing a very reliable and safe end product. It is recognized that other people will have different methods of doing things, and may disagree with specific methods and procedures that I use and opinions that I may have about this subject.

Overview

Factory-built performance cars, with few exceptions, are plumbed with steel fuel line on the pressure side of the fuel system (the line from the mechanical fuel pump to the carburetor). These factory-built lines have threaded connections and flared fittings on their ends, and they're built to be strong and reliable. There's a very good reason for this: Pressurized gasoline in a hot engine compartment presents obvious hazards, so the factory does not use rubber tubing or degradable flexlines on the pressurized part of the fuel system. So why do we see so many performance enthusiasts using rubber line in their engine compartments?

One reason for using rubber line is that many aftermarket carburetors require the use of an in-line fuel filter. Most available in-line filters are designed for use with rubber fuel line, so you don't have much of a choice, right?

Wrong. By selecting the right parts, you can build a bullet-proof fuel line, complete with a screw-on fuel filter, that will flow well, look good, and be safe. What more could you want from a fuel line?



How many times have you seen a fuel line like this? Not only does it look bad, it's simply unsafe.

Tools and Equipment Required

As a minimum, you will need the following tools:

1. Tube bender for 3/8" tubing (Bluepoint brand bender for multiple-sized lines shown in photo)
2. Tube cutter
3. Double-flare tube flaring tool set
4. Small diameter round file, or swiss file
5. Fine flat file
6. Grease pencil
7. X-Acto knife



All the tools needed to build the ultimate fuel line system. If you build a system for yourself and a friend, these tools will nearly pay for themselves.

Materials Required

If you're building a basic fuel line running directly from the fuel pump to the carb inlet (stock type, one-piece line with an inverted flare fitting on both ends – typically used on QuadraJet and factory installed Holley applications) all you need is the following:

1. 3/8" diameter x 40" long pre-flared brake line with inverted flare fittings, NAPA part number 8131243.

If you're building a line with an in-line filter, you need to get the following parts and materials:

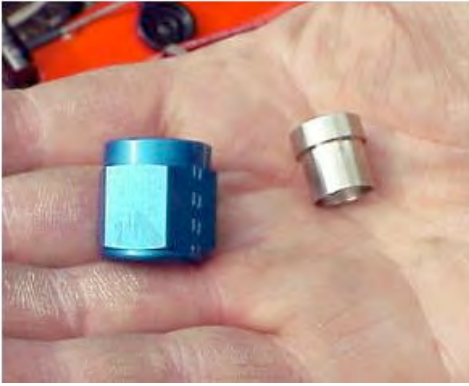
1. GF481 AC Delco high pressure fuel injection fuel filter
2. GM Fuel Line part number 22527595
3. Two 3/8" steel inverted flare fittings (available as general stock at NAPA)
5. Any special AN-Type ferrules, sleeves or fittings to mate up to the carb type you are using:
 - a. The special AN-type fittings used in this article were:
 - i. AA67033-6K Stainless Steel Sleeve Ferrule (from Allan Aircraft Supply – same as MS51533-6) Available in blue anodized aluminum from Summit Racing under part number **EAR-581906**
 - ii. AA67032-6K Flared Tube Coupling Nut (from Allan Aircraft Supply – same as MS51531-6) Available in blue anodized aluminum from Summit Racing under part number **EAR-581806**
 1. (Allan Aircraft Supply Co., North Hollywood, CA (818) 765-4992. AA parts available through most local aircraft industrial supply houses.)



Screw-on high pressure GM fuel filter for late-model fuel injection applications (such as '85 Corvette). This filter is designed for use with a special "O"-Ring type fitting, such as those used on air conditioning systems. The filter cannot be used with a simple flared tube fitting. This is a high-flow, high pressure filter with outstanding reliability.



When you order part number 22527595 you'll get a straight piece of 3/8" fuel line about 8 feet long that's intended for use on a 4x4 Chevy Truck and a full-sized Oldsmobile (among other things). This line has been pre-formed on both ends with an "O"-Ring style flare, and comes with the "O"-Rings, the special fittings, and two sections of spiral-wrapped "armor." All the parts needed for the ultimate fuel line.



For our application, we needed to mate up to a Demon Carb inlet line. This line has “AN” flared connections. We decided to use the supplied Demon aluminum “AN” flare nut, and added an “MS” type ferrule to mate the nut to a flared tube end. The Ferrule is a stainless part obtained from Allan Aircraft Supply under part number AA-67033-6K. The aluminium Flare Coupling Nut is available in stainless steel under Allan Aircraft part number AA67032-6K. The sleeve and the nut must be used in combination with the single flare on the tube to produce a good flare seal. Both parts are available in blue anodized aluminum from Earl's (from Summit Racing).

Procedure

Here is my recommended sequence and procedure for building a fuel line:

1. Cut the fuel line.

If you're working with the NAPA brake line, you're not going to be using the flared ends that are provided; you're going to be doing your own flaring. The only reason you bought the flared line was to get a good piece of straight tubing and two fittings. So cut the ends off the line and remove the fittings.

(The reason for cutting both ends off is that you cannot bend the tube close enough to the installed fitting to make the tube bend sharply enough coming out of the fuel pump. By cutting the end off, bending the tube, and then re-cutting and flaring the tube end, you can get the bend very close to the end fitting. If you start the fabrication process from the carb and work your way down to the fuel pump, you can use the provided flare and nut on one end of the tube, but the tube development process is much more difficult if you start at the top and work your way down rather than starting at the pump and working up to the carb.)

If you're working with the long GM “O”-Ring line, cut it in half and remove the armor.



Cutting the line

2. For the 1-piece line, start at the fuel pump.

You'll need to make a sharp bend that curls the line around over 90 degrees right out of the fuel pump. Bend the line close to the one end, but give yourself enough extra material that you end up with a short straight section to the end of the line.

3. For the In-Line filter line, start by locating the fuel filter where you want it to be.

The most common location for the filter is in front of the cylinder head. This allows you to place the filter upright, and this eliminates most of the air that may become trapped in the filter. With this location determined, start bending up a piece of your "O"-Ring line from the filter inlet down towards the fuel pump.



Bending the sharp 90+ degree bend at the fuel pump outlet. On a 1-piece line, this is the first bend you'll make. On the in-line filter line, this is the last bend you'll make. Notice that we have a nice section of straight line after the bend to the end of the tube.

4. Cut the line at the fuel pump.

With the sharp bend at the fuel pump completed, slide the inverted flare fitting onto the tube, and jam it as far into the bend as it will go. Place your tube flaring tool onto the tube up against the inverted flare nut. Mark and cut the tube, making allowance for how much tube you need to complete the flare. This procedure allows you to cut the tube as close as you can to the sharp bend you've just completed.



Marking the tube for cut length with the flaring tool in place.



This is how much tube you must have sticking out of the flaring tool after the cut. Anything less, and you won't be able to complete the flare. Any more, and the tube will stick too far out of your fuel pump.

5. Prep the tube for flare.

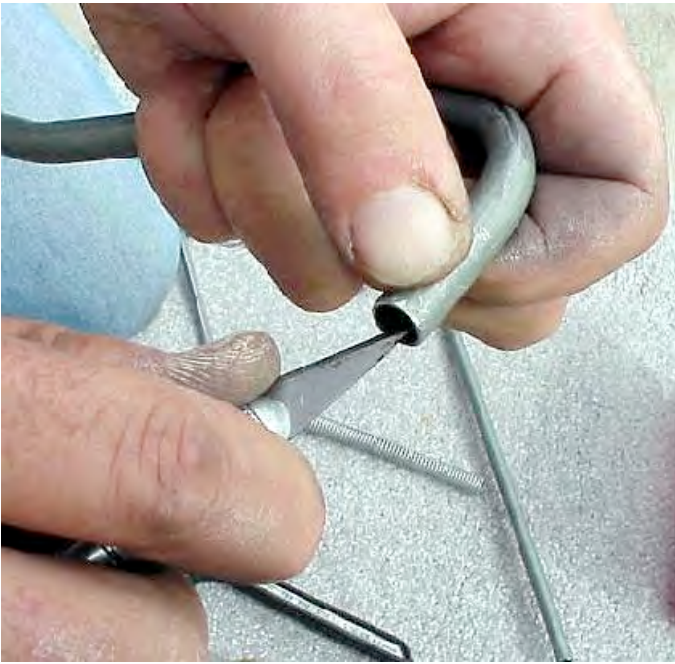
The most important part of a tube flaring operation is the tube prep. You cannot prep the tube too much. A poorly prepped tube will produce a flare that is defective, and such a flare will leak. Here is the prep sequence:



Use the deburring tool on your tube cutter to do the initial deburring of the inside of the tube. This will remove most of the ridge from the cutting operation.



Use your file, and file the inside of the tube to smooth it out completely. There can be no ridges or risers on the inside of the tube.



Now take your X-Acto knife and run it around the inside of the tube to produce a completely perfect inside diameter prep.



Finally, use your fine flat file to file the end of the tube completely flat, square and smooth, and to deburr and slightly round off the outside diameter.



Here is the finished, properly prepped tube end. No burrs, ridges, or defects of any kind.

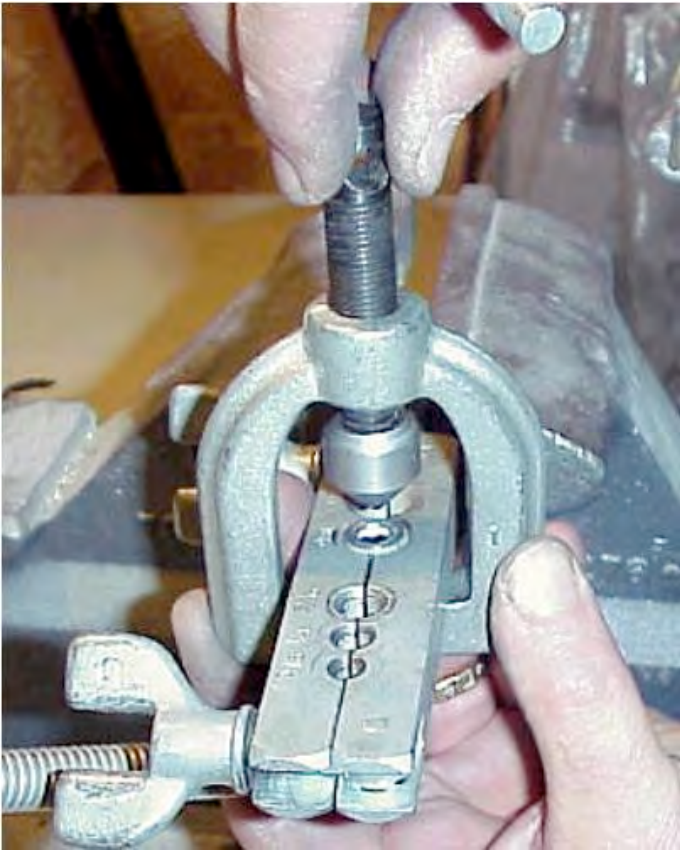
6. Flare the tube.

An inverted flare fitting needs a double-flared tube to seal properly. This double-flare is a two-step operation. First, with the flaring tool firmly secured in a vice, insert the tube into the tube flaring tube with the right amount of tube sticking up out of the tool (see picture under step 4 above). Make sure your flare nut is installed onto the tube, and install any of the spiral wrap armor you might wish to use. Clamp it down good. Using the double-flare spacer tool, perform the first “crushing” of the tube.



The tube end being “crushed” by the double-flare spacer in the first step of the operation.

Once the tool has been screwed all the way down until seated, remove the double-flare tool spacer and flare the end of the crushed tube with the flaring tool. Screw it down tight to properly form the flared end:



Flaring tool being directly inserted into the end of the crushed tube with the double flare spacer removed.

Remove the tube from the flaring tool and deburr it and wipe it down. A ScotchBrite pad works well for the cleanup and deburr operations.



Final flared tube end after clean-up. Note spiral wrap armor installed over the tube section.

7. Finish tube bending.

With the lower flare at the pump completed, finish bending up your line with the tube bender. I make good use of my grease pencil to mark the tube for bend locations and angles, taking my time to make accurate guesses about the bends. I fit the tube in place frequently, screwing it into the fuel pump and methodically placing each bend at the best location possible. For the in-line filter tube, form and bend up the upper section of the line just as you did the lower section.



Bending up the upper section of the in-line filter line.

8. Perform final flaring.

If you're building the one-piece line, you'll simply mark and cut your tube at the carburetor inlet fitting once you get your tube bending/development completed. Prep and flare the tube just as you did before, and you're ready to install the completed tube assembly. If you're building the in-line filter tube and you're mating up to an inverted flare connection, the same process applies.

Some carbs and fuel systems, such as the Demon inlet systems, use AN fittings at the carb. You can flare your fuel line to accept these fittings very easily. You need a sleeve installed over the line, and your AN nut slips over this sleeve. The flare must be a single flare – not a double flare, so you will not use the double-flare crushing tool that you used earlier. Try the single-flare process out on some scrap tubing before you proceed with the real thing: the height of the tube sticking up out of your tube bender is critical to obtaining a good single flare, so try it out a few times on some scrap before you flare your real fuel line.

On a single flare such as this, you can get soft aluminum flare seals, or “Flare Savers” (often called “DelSeals”) from your local aviation industrial supply store. These are not necessary, but they produce a very nice, tight seal of the flared fitting.

A note about AN Flares versus SAE Flares: Automotive flares and flare tools are 45-degree flares. “AN” flares are 37 degrees. It is not “technically correct” to use a 45-degree flared tube with the 37 degree AN fittings, and for military and aviation use, this is not allowed: The 37-degree flares are designed to operate safely in systems up through 3,000 psi, so a flared angle mismatch is not allowed under these conditions. We never see such pressures in auto fuel systems. In actual testing that I have done, I have found that the 45/37 combination works safely and reliably in pressure systems up to 250 psi. In applications above 250 psi, the line-interface created by the angle mismatch can start to leak if the fittings are not re-torqued. In automotive fuel systems operating at 4 to 8 psi, the 45/37 interface works reliably and flawlessly, without the need to re-torque. Much more reliably than a rubber fuel line with a clamp... However, if you want to create a “perfect” flare interface, 37-degree flare tools are available from aviation supply houses. You will not notice any difference in system reliability between the two flare angles in this automotive fuel system application.



Completed single-flare tube end with the correct AN fitting and the Ferrule installed. The AN fitting shown is supplied with the Demon carb inlet fuel line. We could have installed the stainless steel AA67032-6K Flared Tube Coupling Nut referenced in the List of Materials in its place, but the blue aluminium nut looks and works well in this application. Soft aluminum Flare Saver shown on the end of my finger.

9. Finish it up and install it.

You now have a completed fuel delivery system. Make sure you blow out or flush out the tubes you've fabricated to avoid getting any metal particles into your carb. Fit the system up and install it on the engine, snugging all the fittings up well. The "O"-Ring filter does not have to be tightened very tight to obtain a good seal, so don't over-torque these connections. If you rub the line with a rag and a little rubbing compound, it will look like it's chrome plated. Be sure to do a leak-check as soon as the engine fires.



Completed line with in-line high pressure fuel filter. Lower section of line has been protected with the armor spiral wrap. This will keep the line safe from rocks and broken fan belts.



1-piece steel fuel line installed on a Holley with in-carb filters



Completed in-line filter line with "O"-Ring fittings at filter and AN fittings at Demon carb.

Optional Fuel Filter Type

For a more custom appearance, and as an alternative to using the “O”-Ring GM fuel filter, you can also install an AN-Flare type inline filter, such as Summit part number SUM-G1517.



This filter is slightly smaller than the GM filter, allowing more flexibility in installation location. You’ll need to add two more of the fittings and sleeves to your material list, and you’ll need to flare the fuel line to interface with the filter.

Parts needed:

In-line fuel filter with threaded connections for 3/8” Fuel line: SUM-G1517

3/8” Aluminum Tube Nut: EAR-581806

3/8” Aluminum Tube Sleeve: EAR-581906



Here is a completed fuel line using the Summit AN-type fuel filter. The O-Ringed GM fuel line is not needed to build this assembly.

Other Information:

For those of you running Barry Grant carbs, note that you cannot use Holley style inlet fuel lines: The Holley carbs use inverted flare connections into the carb; BG does not. The BG carb shown in the photos in this article is equipped with BG inlet line Summit part number BGI-140020. This inlet line will interface with a flared –6 (3/8”) steel AN line system, or it can be used with a supplied barbed inlet fitting for use with flex hose.



Interfacing with Aftermarket Fuel Pumps

Stock Delco mechanical fuel pumps have a female inverted flare connection at the pump for direct attachment of a fuel line with an inverted flare fitting (as described above in this article). Many aftermarket fuel pumps (Holley, Carter, BG) have 1/4” pipe thread outlets on the pumps, and they are not compatible with an inverted flare fuel line. If you have one of these aftermarket pumps, you can buy a Weatherhead 90-degree fitting from most NAPA stores that has a 1/4” male pipe thread on one end to interface with the

pump, and a 3/8" female inverted flare on the other end of the 90-degree to accept an inverted flared tube as described in the article. Use of this 90-degree fitting eliminates the need to make the sharp fuel line bend coming out of the fuel pump. You can also get an Earl's 1/4" pipe -6AN 90-degree fitting if you want to run an AN-style connector instead of the inverted flare at this location. This makes a very clean setup.

Questions, Comments & Technical Assistance

If you have questions or comments regarding this article, or if you notice any errors that need to be corrected (which is quite possible since I'm writing this from memory...), please feel free to drop me an e-mail. Also, if you need any technical assistance or advice regarding this process, or other maintenance issues, feel free to contact me:

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