Late Spiders - Forming Bubble Flares on Brake Lines

Brake lines on 30 year old cars often require replacement. In addition to the inevitable corrosion, the connections are damaged during multiple replacements of the brake components attached to them.

The Fiat 124 Spider is especially prone to brake line connection issues because the line themselves are quite small, only 4.75mm at the caliper ends. Late Spiders use a style of brake line flare require the application of high torque on a small nut to seal. This article demonstrates how these so-called bubble flares can be formed with simple tools.

Figure 1 - End of the Line

Figure 1 shows a section of original factory line from a 1981 Fiat Spider 2000. The flared end just extends beyond the non-threaded nose of the line nut. The sealing surface is just before the tip and has a slightly convex shape. The shoulder of the nut applies pressure to the widest portion of the flare.

This style is known as a bubble flare due to its rounded shape. It is sometimes called a DIN, an ISO, or a GM flare. I believe it was used on Spiders only from 1979 to the end of production in 1985. Earlier 124 series cars use a more common double flare fitting. Many older American cars use a third type called a single flare. AN flares are yet another style.
Some describe a bubble flare as a double flare that was interrupted in the making, but that is not how they are actually formed. Instead the brake line tube is compressed back on itself with most of the excess material winding up on the forward side of the flare and the back side formed almost into a right angle to the tube.

To form a double flare, a die inserted into the tube prevents the line from collapsing inward but the die is screwed onto the threaded shaft that drives it in order to keep the line hole as centered as possible. A double flare tool can doubtless be used to make bubble flares. For that matter so can a hammer and a vise-grip. It just depends on how much time and care you put into the forming and the number of failed attempts rate you are willing to make.

Fiat used metric fittings. The line OD is 4.75mm. The line nut has a 10mm hex and a M10 x 1.25 thread. This is not a common fitting size but can be found with some searching. Avoid the more common SAE and M10 x 1.0 nuts that almost match. The flare has a DIN (metric) spec for diameter and depth.

The 1.25mm thread pitch used by Fiat is too coarse for the torque capacity of the small hex. The high force needed to seal a bubble flare results in the hex becoming distorted in just one or two replacement cycles despite the use of a flare nut wrench. Once that

Figure 2 - Bubble Flare Tool Kit
happens the line must be replaced or the original flare must be cut off to permit replacement of the nut and a new flare formed with the line still on the car.

Professional auto mechanics use a hydraulic flare tool and precision dies to form a bubble flare but this equipment is too expensive for a home garage. There are a number of less expensive tool kits available that require more patience and some trial and error but can still get the job done. One such kit is shown in figures 2 and 3. It is distributed by OTC. It is their Stinger ISO Bubble Flaring Tool Kit, part number 4504. I paid $22 plus shipping from Amazon in Jan. 2012. Look around, there are others also.

![Flaring Tools](image)

**figure 3 - Flaring Tools**

The forming bar is open in the figure 3. Each of the notches corresponds to a metric brake line diameter. 4.75mm is the smallest. 10mm is the largest.

If the brake line cut is not square across the tube length the flare will not form properly. In addition to the tool kit, you will need a sharp tube cutter to form a perfect cut. If you are working on a line that's still installed on the car, there may not be space to swing a regular plumbing tube cutter.

The midget cutter I used is in the upper right corner of the previous picture. It's Ridgid model 32975. It did not come with the kit but it did come from Amazon. The combination
of the $22 flare tool kit and the $12 cutter qualified the order for free shipping in Feb. 2012.

![Image of deburring tool and screw]  

**figure - 4 Deburring**

The 4.75mm OD brake line used by Fiat has a tiny inside diameter. Burrs often form on the inside edge of the cut. So after cutting the tubing and before starting to form the flare the inside edge of the new tube end needs to be deburred. None of my standard deburring tools fit the small tube opening so I used a small cone shaped diamond tool shown in figure 4 in a Dremel type rotary tool.

The picture above shows the flare already formed. I did the deburring before forming the flare. After forming I cleaned up the sides of the tube and the backside of the flare with a fine wire wheel in the same Dremel. The forming bar leaves raised material on the sides of the line that can interfere with the nut fitting squarely on the flare. If the nut is cocked, there is a good chance of cross threading it.

Figure 5 shows the forming bar. Look closely at the inside of the larger bores and you can see the ridges that bite into the sides of the tube to hold it in place. The back side of the flare is shaped by the recess in the top of the bar.
figure 5 - Forming Bar

Tighten the wing nut closest to the line first. Then do the nut at the far end. You'll get more leverage and won't need to use a set of pliers to finish the job. The wing nuts were not fully tightened in this picture.

figure 6 - Tube Gauge
The end of the sample brake line in this picture still has a square outer edge and a ridge left by the tube cutter on the inner edge. Both need to be removed.

Figure 6 shows the tube gauge in use. The distance that the tube extends out from the forming bar is a critical variable. This picture shows how to use the height gauge to position the line in the forming bar.

The cut on this line was not properly deburred and a rough edge is holding the gauge off the end in this picture. If not corrected the error will give you a flare that's too small. It also helps the quality of the flare to round the square outside edge off the tube end with a file or grinding stone.

The hex in the end of the gauge fits the hex on the forming dies and aids in extracting the die from the finished flare.

Figure 7 shows the starting point of the actual forming process. The point of the die has not yet been driven into the tube end. Lubricating this die tip with a little brake fluid helps. Lubricating the threads of the press screw with oil reduces the force needed to turn the screw and tighten the clamping.
Figure 8 shows the starting point of the actual forming process. The point of the die has not yet been driven into the tube end. Lubricating this die tip with a little brake fluid helps. Lubricating the threads of the press screw with oil reduces the force needed to turn the screw and tighten the clamping.

Getting a good flare with simple tools requires practice and knowing what to look for. I recommend finding a spare section of line and making at least eight or ten practice flares before attempting the actual repair.

In figure 9, the flare on the left was stopped before it reached full diameter or was positioned with too little line extending above the bar. The flare on the right was driven too far or used excessive line length. The tip of the flare has a sharp squared off edge and does not form a curved seat. Also, the overall diameter of the flare may be too large for the nut to fit over. The flare in the center is adequate though the curved area at the tip looks a little higher on one side that the other, possibly because the line cut was not made squarely.

The test of an adequate flaring job is whether the joint seals on the vehicle without applying excessive force which will distort the line nut in the process. Using a flare nut wrench, also called a line wrench, will minimize damage to the hex. It looks like a box wrench with one of the six sides of the hex removed.

Steel lines work hardens with each tightening cycle. If the joint does not seal properly on the first or second attempt, you are probably going to have to start over with a new bubble.
If you run out of line before making an acceptable flare and don’t want to replace the entire line back to the master cylinder you can find replacement line sections with pre-made flares at a good auto stores. They also sell union fittings that permit replacement line sections to be spliced in using a flare tool.

One of the downsides of using a simple flaring tool are the shiny tooling marks you can see across all three samples. Expensive hydraulic tools clamp the line in a way that avoids damaging the line. Cheap tools use serrated gripping ridges on the inside of the forming bar that dig into the sides of the tube to hold it in place as the die is pressed down on the tube end. I wire brush the raised metal on the sides of the line after forming but they doubtless reduce its strength. Careful attention to supporting the finished line and tying it down on the chassis will minimize line flex and vibration and reduce the chance of cracking at these weak points.

Disclaimer: If you are new to auto mechanics don’t start your learning process with components that directly affect the safety of yourself, your passengers and others who share the road with you. Brake hydraulics are a good example of mechanical work that
benefits greatly from proper tools, training and experience. Entire pre-formed brake line sets are available for the Fiat 124 Spider with the appropriate flare style and flare nuts already installed for most model years. Flares of all types but particularly bubble flares are best formed using closed die hydraulic flaring kits. $10-20 to have a proper flare made by a professional mechanic is money well spent.