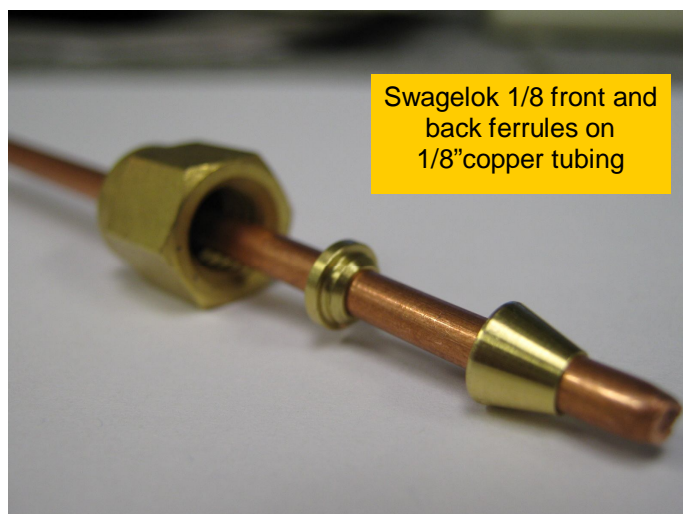


Using Ferrules with SRI GCs

Gas-tight seals on all tubing and connections are essential for good gas chromatography. Hard and soft graphite, stainless steel, brass, vespel, and teflon ferrules of many types and sizes are used to secure different types and diameters of tubing to all the connections on the GC.

In general, ferrules will be driven into the connection by the tightening of a nut. Ferrules are essential because they seal connections not through the threads of the nut, but by pressing the ferrule up against the mouth of a connection.

To complete the connection, some ferrules use two separate parts, a front and back ferrule, while others use only one. At right are examples of ferrules that use both a front and back part: 1) Swagelok 1/4" brass ferrule, 2) Hoke 1/8" brass ferrule, 3) Swagelok 1/8" stainless steel ferrule, 4) Swagelok 1/16" stainless steel ferrule.



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There are many different types and sizes of **brass and stainless steel ferrules**, but their basic use and installation is the same. Brass ferrules are softer and more reliable when connections are made and remade several times while stainless steel is best under operating temperatures exceeding 300 degrees. We will illustrate how to install a **two-part ferrule** with 1/8" copper carrier gas tubing and a 1/8" Swagelok brass nut and 1/8" two-piece ferrule.

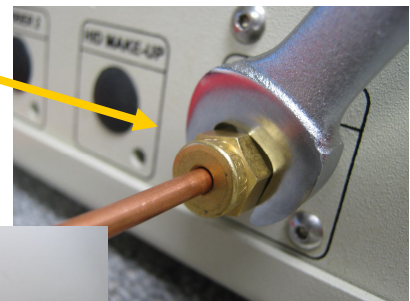
Slip the nut over the tubing with the threaded opening facing outwards. Place the brass back ferrule onto the tubing with the narrow end facing outwards. Slip the brass front ferrule onto the tubing also with the narrow end facing outwards. The two ferrules are designed to fit together.

Thread the nut either straight onto a male fitting, or, preferably onto a stainless-steel cap first and tighten with a 7/16" wrench (two wrenches if you are using a cap). It's a good idea to use a new and undamaged stainless male fitting the first time you tighten up the ferrule because this will ensure the ferrule takes the correct shape. Brass fittings are sometimes deformed from past over-tightening.

You should turn the wrench approximately one-half turn past finger tight in order to get the proper tightness. If the ferrule is too loose it will not produce a gas-tight seal, if it is too tight the ferrule can be smashed or deformed and also prevent a gas-tight seal.



Okay . . .



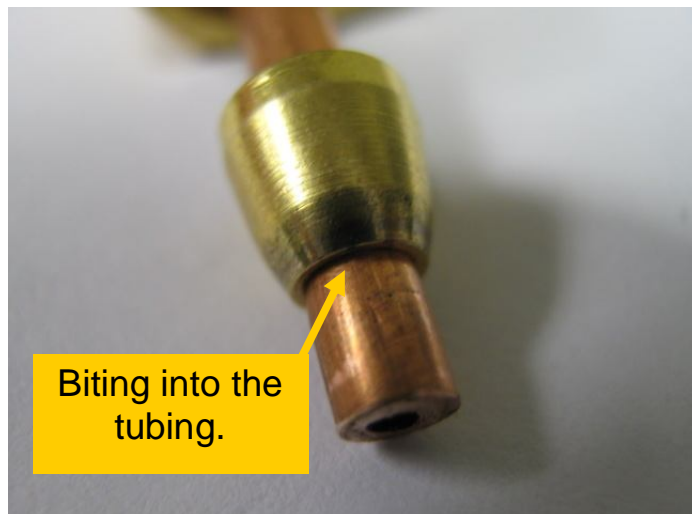
...but this is better because the stainless cap is more likely to form the ferrule to the proper shape than a possibly deformed brass fitting

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After being properly tightened, when you remove the nut from the fitting or from the cap you will notice the front and back ferrules are seated onto each other and have “bitten” slightly into the tubing. The ferrules should not slide freely on the tubing. If they still can move freely on the tubing, tighten the nut a little more.

The installation of one part ferrules is very similar process, here it is illustrated with 1/8” copper tubing, a Swagelok 1/8” brass nut, and a 1/8” Parker brass ferrule. Place the nut onto the tubing with the threaded side facing outwards. Place the ferrule onto the tubing, narrow end facing outwards. It is best not to mix and match nuts and ferrules from different manufacturers, but it can work if the correct parts are not available.

As with the two-piece ferrule, tighten the nut one half turn past finger tight either onto the fixture or into a 1/8” end cap. When the nut is removed the one-piece ferrule will be seen to be “biting” slightly into the tubing and will not slide up or down.



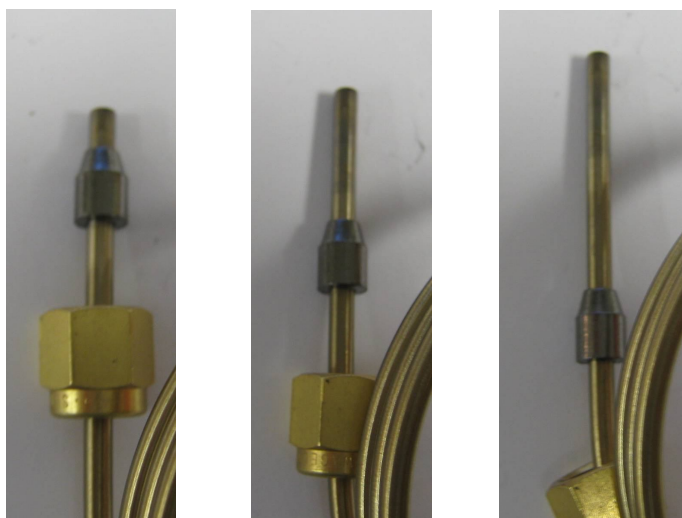
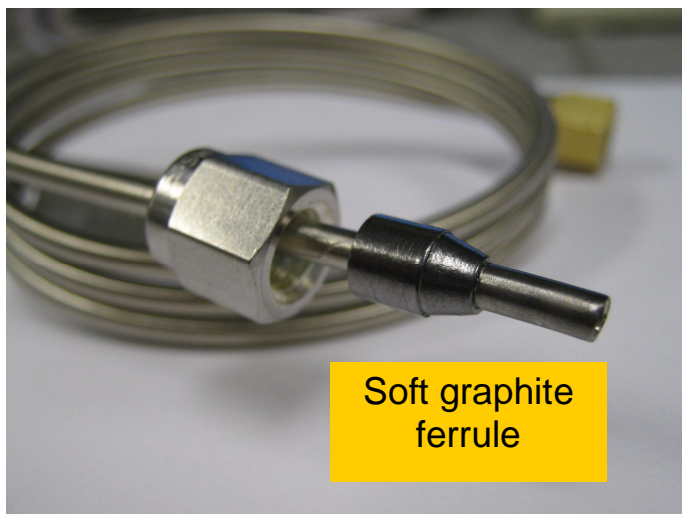
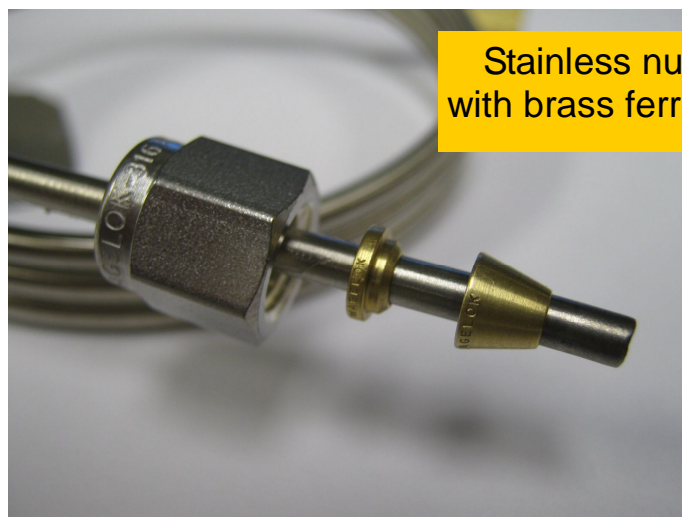
Using Ferrules with SRI GCs

Brass ferrules are the preferred method for sealing most tubing connections and they can also be used on the 1/8" stainless-steel tubing used for packed columns in SRI GCs. If the packed column is going to be connected to anything other than the injection port, slip a stainless (stainless is preferred for temperatures above 200C since the brass nuts will discolor) 1/8" nut over the end of the column, threaded side facing out. Then add the back and front ferrule to the tubing and tighten as described previously.

If the end of the packed column is going straight to the injection port a 1/8" soft graphite ferrule should be used instead. Slip a 1/8" stainless steel nut over the tubing, threaded side facing out. Place a 1/8" graphite ferrule onto the tubing with the narrow end facing out. Avoid getting particles of graphite inside the column.

Unlike the brass ferrules, the graphite ferrule can be placed at variable distances from the end of the tubing. This is helpful when positioning the column in the injector. Also the nut and ferrule can be removed and replaced whereas the brass ferrule is difficult to remove. With graphite ferrules one always has the choice to use either hard or soft graphite. Soft graphite makes the best seal but can outgas organic compounds which may show up as baseline bleed. Hard graphite ferrules bleed less, but are prone to shrinkage after the first heating cycle and may leak as a result.

SRI's general rule is to use soft graphite at the injector end of the column and hard graphite at the detector end.

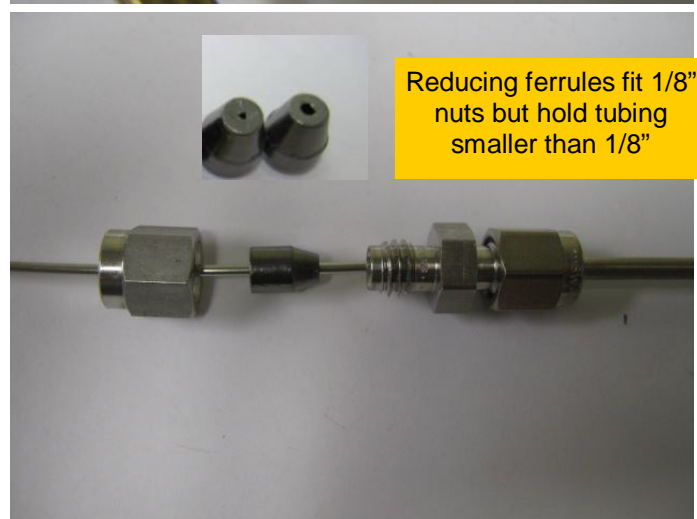
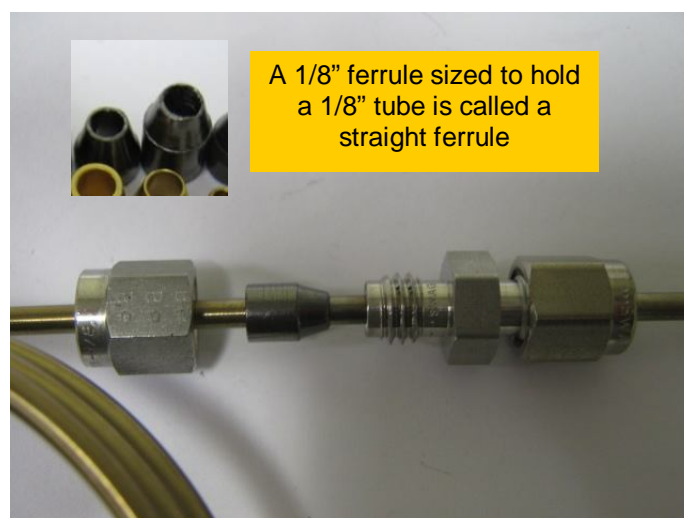


Using Ferrules with SRI GCs

When connecting the column to the injection port, make sure the end of the column is situated the proper distance inside the injection port and tighten the nut with your fingers as far as it will go. Take the $7/16$ " wrench and tighten the nut about one half turn. You should be able to feel the ferrule squish slightly, and the column should not slide even if you tug on it. **Soft graphite ferrules can be smashed or broken if they are tightened too much.**

Graphite ferrules can be used to connect packed column tubing to other connections besides the injection port, but metal ferrules may also be used.

Graphite reducing ferrules can connect different sized nuts to different sizes of tubing to create a gas-tight seal. In the example to the right $1/16$ " stainless-steel tubing is connected to a $1/8$ " fitting. Graphite reducing ferrules are oftentimes more convenient and less expensive than installing a Swagelok reducing union and metal ferrules. Reducing ferrules are available in many sizes in both hard and soft graphite materials.



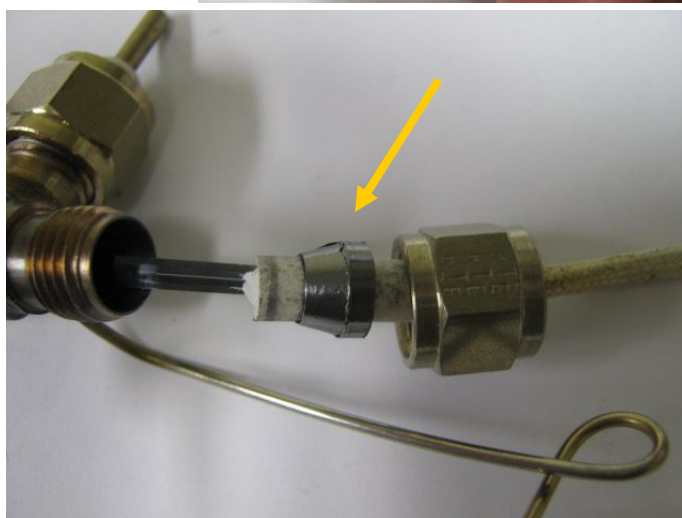
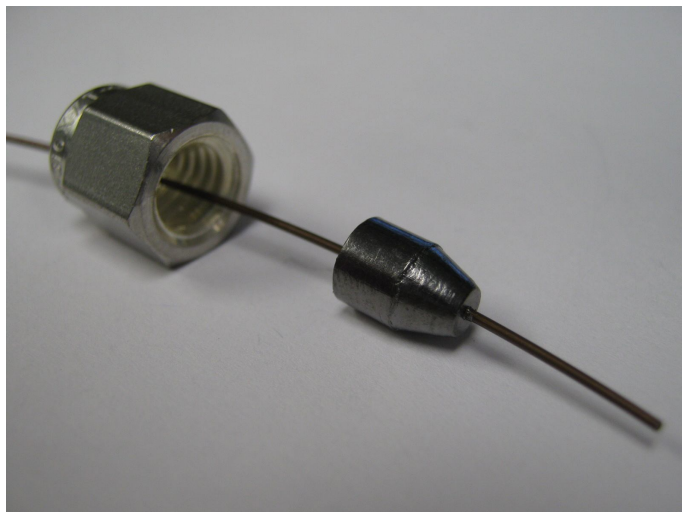
Using Ferrules with SRI GCs

Soft and hard graphite reducing ferrules are used to fit 0.53 mm id (the od is .8mm) capillary columns onto connections and tubing. First, slip a 1/8" stainless steel nut onto the capillary column tubing with the threaded side facing out. Slide the graphite reducing ferrule over the tubing with the narrow end facing out.

Because the graphite is soft and the capillary tubing can be sharp, small graphite shavings may be driven into the end of the capillary column when adding a ferrule. It is a good idea to trim about half-an-inch off the end of the column **once the ferrule is on the tubing**. Use a column cutting tool or metal file to make a notch in the capillary column, then snap it off over your thumb nail.

A 1/4" straight graphite ferrule is used to secure the igniter into the FID detector body. Slide the 1/4" nut over the white ceramic shaft of the igniter with the threads facing towards the FID body. Slide the graphite ferrule, narrow end facing towards the FID and then screw the nut onto the body of the FID. This seal does not have to be over-tightened, finger tight is fine.

Be careful not to turn the ignitor while tightening the ferrule or the heater blade may snap.

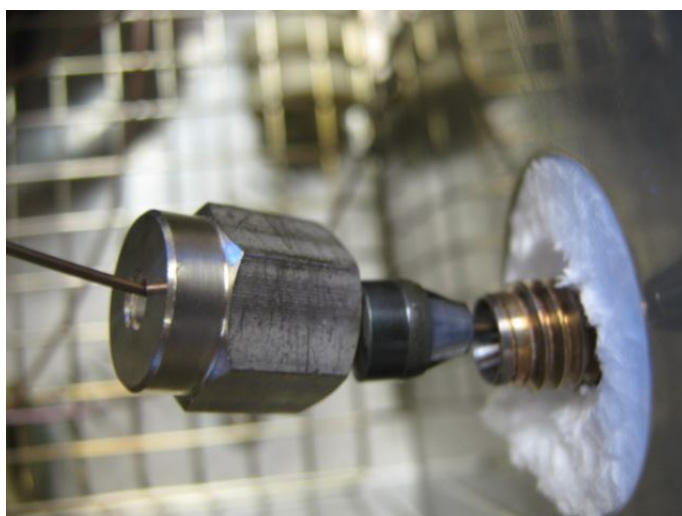
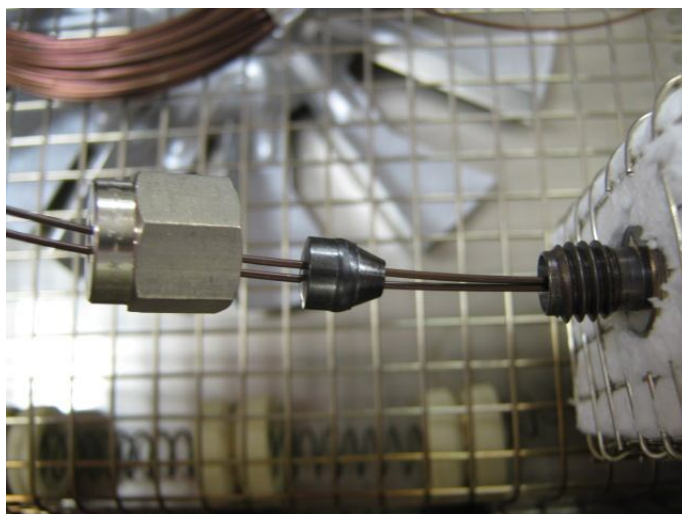


Using Ferrules with SRI GCs

Graphite reducing ferrules are available with two holes instead of one. Here a two hole hard graphite reducing ferrule secures two .53mm capillary columns into the heated injector. When sample is injected, it is split onto the two column.

Here a hard graphite reducing ferrule secures the column to the FID detector. Hard graphite is preferred for the column to detector connection because hard graphite bleeds less producing a flatter baseline at high temperatures.

Soft (not hard) graphite ferrules can also be used to connect 1/8" and 1/16" Teflon tubing to fittings. In the example to the right, a 1/8" to 1/16" graphite reducing ferrule connects 1/16" Teflon tubing using a 1/8" nut. Unlike brass or stainless steel ferrules, graphite ferrules are less likely to restrict the flow of gases by crushing the Teflon tubing.



Using Ferrules with SRI GCs

Brass ferrules (either 1/8" or 1/16") can also be used to secure 1/8" or 1/16" Teflon tubing. The procedure is the same as with the stainless steel tubing except that greater care should be taken when tightening the nut and ferrules to ensure that they don't block off the flow of gas through the tubing.

Depending on your GC configuration, you may have a Valco valve. Valco valves use their own nuts and ferrules to secure their connections. Slip a Valco nut over 1/16" stainless tubing with the threads facing outwards. Slip a brass Valco ferrule over the tubing with the narrow end pointing outwards. SRI prefers brass Valco ferrules, but they are also available in stainless.

If you happen to have an extra Valco valve head or Valco fitting lying around use that to secure the ferrules to the tubing. Otherwise, place the end of the tubing into one of the threaded valve openings, push it in as far as it will go and tighten the nut into the valve head using a 1/4" wrench. Tighten the nut until snug but not over-tightened. It is recommended that you remove the fitting from the valve and inspect the ferrules to ensure a proper connection, before retightening.



Using Ferrules with SRI GCs

To remove brass or stainless steel ferrules from metal tubing it is best to simply cut off the end of the tubing with the ferrules attached. Hard and soft graphite, vespel, and Teflon ferrules can simply be pulled off the tubing.

Brass ferrules attached to packed columns can sometimes be removed by using a ferrule removing tool. Place the end of the column against the “tooth” of the tool and secure the ferrule behind the slot in the tool. Squeeze downward with ample force in an attempt to slide the ferrule off the tubing. If the ferrule was over-tightened it may not be possible to remove it using this tool. Stainless ferrules are very difficult to remove so you usually have to cut the tubing.

You can also place the end of the column in a vice with the back ferrule resting against the top of the vice. Use a hammer or other pounding tool and gently pound the end of the column until the ferrule has worked itself free. Pliers may also be helpful when loosening ferrules from columns. The column tubing is frequently damaged after a metal ferrule is removed so cutting the tubing is often required.

