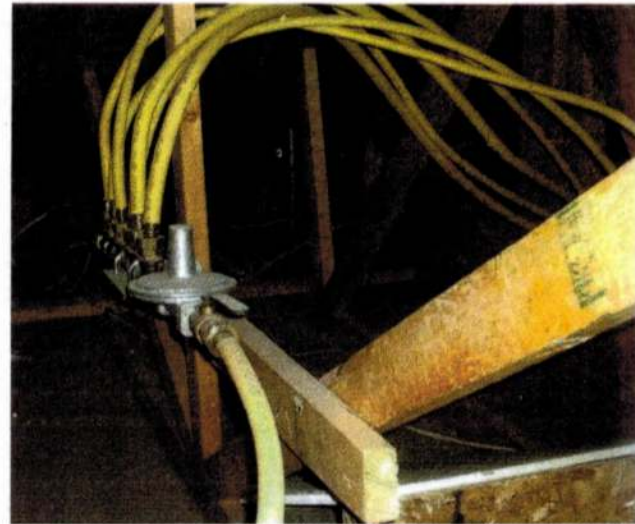


Corrugated Stainless Steel Tubing (CSST) & Flexible Appliance Connectors (FAC)

BY BRUCE BARKER, ACI

Picture 1, © 2012 Dream Home Consultants, LLC



ONCE AGAIN THE WORD INVITES YOU TO TRAVEL INTO the dark realm of subjects that are sometimes misunderstood by home inspectors. The Word hopes you will find this trip informative and maybe a little entertaining.

This month's subject is **corrugated stainless steel tubing (CSST)** and **flexible appliance connectors (FAC)**. The Word finds this subject interesting because there seems to be some confusion out there about the differences between these two components and about how they should be installed.

What's the Difference?

Both CSST and FAC are components that carry gas (natural or propane) from point A to point B. Both are flexible. Both are made from stainless steel. They even have similar names. FAC are known in the industry as corrugated stainless steel connectors (CSSC). It seems like someone is trying to make things confusing.

That's where the similarities end. CSST is a gas distribution system like good old black steel pipe. FAC are short lengths of tubing that are intended to connect between the gas distribution pipe (or tubing) and the appliance (*See Picture 3*).

Here are some ways to distinguish between CSST and FAC. A common CSST sheathing color is yellow. Other common sheathing colors are black and orange. FAC are often yellow too and perhaps that's part of the identification confusion. Other common FAC colors are silver, gray, black and blue. CSST is usually larger ($\frac{3}{4}$ " and 1"+) than FAC ($\frac{3}{8}$ " and $\frac{1}{2}$ "). One good way to distinguish between the two is that FAC are between 1 foot and 6 feet long with a factory-installed connector on each end. Another good way is that FAC are painted and the corrugation is visible while CSST is sheathed and the corrugation is not visible.

Uncoated Brass FAC

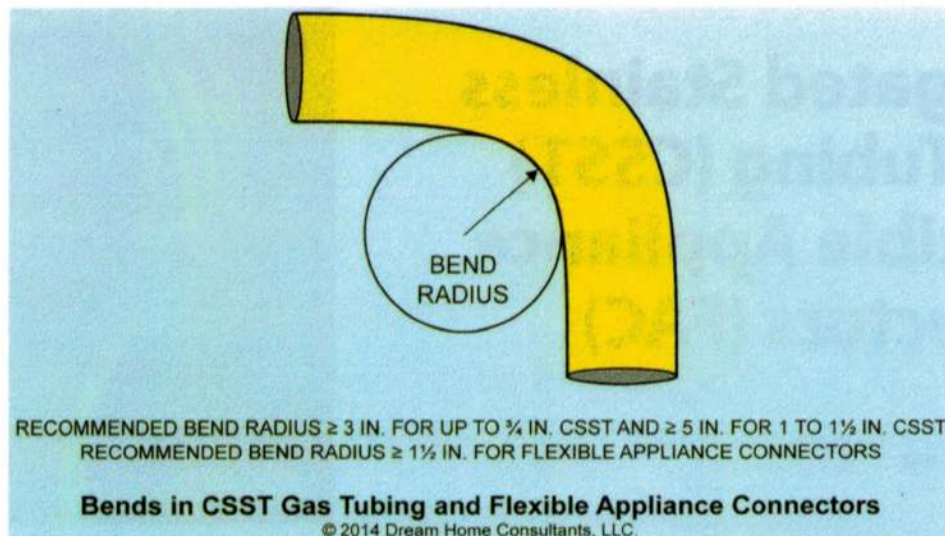
Some FAC from the 1970s are brass-colored with no paint or coating. These FAC are a known gas leak hazard. You should report their presence and recommend immediate replacement. They should have been replaced a long time ago regardless. One common manufacturer's installation instruction is that FAC are recommended for one-time use with one appliance only. When the appliance is replaced, the FAC should be replaced, too. Here's the CSPC website about these hazardous connectors: <http://www.cpsc.gov/CPSCPUB/PREREL/PRHTML97/97003.html>

CSST Inspection

One common question about inspecting CSST is about support. $\frac{1}{2}$ inch diameter CSST should be supported at least every 6 feet. Sizes $\frac{3}{4}$ inch and larger should be supported at least every 8 feet (6 feet in Canada). Measurement is along the CSST, not horizontally. If CSST is installed as in Picture 1, measurement would be up from the manifold following the CSST. Support is especially important near manifolds and fittings because leaks are more likely at those points. Support material should be metal straps, hooks, bands, or the building structural components. Plastic supports are usually not permitted because they might melt during a fire. Plastic supports may be allowed in some areas. The supports should be of sufficient width and strength to support the CSST without letting it sag or crimp.

Questions about bending CSST are less common, but perhaps they should be more common. Bends will reduce the gas flow and very sharp bends could weaken the tubing. The recommended minimum bend radius is 3 inches for $\frac{3}{4}$ inch and smaller diameter CSST and is 5 inches for CSST from 1 to $1\frac{1}{2}$ inches diameter. The absolute minimum bend radiuses are 1 and 3 inches respectively.

Figure 1



See Figure 1. Since the absolute minimum radii are allowed, be prepared for push back if you report bends less than the recommended minimum.

Another common question is whether CSST may enter an appliance cabinet such as a furnace. The answer is yes for interior furnaces, exterior gas packs and decorative gas fireplaces. CSST may be installed inside a firebox, including inside a masonry firebox, to supply gas logs; however, the sheathing should be removed. CSST should not be installed in a firebox to supply a gas log lighter. There is no specific manufacturers' requirement for a bushing or sleeve to protect CSST when it enters a cabinet. There is a general requirement to avoid contact with sharp objects and edges. A bushing or other protection should be installed if CSST is in contact with a metal cabinet. Remember that a shut-off valve should be installed within 6 feet of most gas appliances and that a sediment trap is also required in most cases, so look for these when CSST enters a cabinet.

Movable appliances are a different story. CSST may not connect directly to appliances such as clothes dryers, ranges and movable outdoor cooking appliances. Even appliances and equipment installed on (but not secured to) concrete pads or on roofs are defined as movable. Connecting to these appliances involves terminating CSST in a secured fitting and making the connection to the appliance with rigid pipe or a FAC.

May CSST be installed outdoors? Yes, if it is protected against physical damage and if none of the stainless steel is left exposed. What does protected against physical damage mean? It's like what Supreme Court Justice Potter Stewart said about pornography, you (or more accurately, the building official) will know it when you (he/she) see it. Outdoors includes rooftops. Like other gas piping,

CSST should be elevated above the roof (and ground) at least $3\frac{1}{2}$ inches or more if required by the building official.

May CSST be installed underground or in a concrete slab? Yes, but it should be installed in a non-metallic, watertight sleeve. Manufacturers don't require that the sleeve be ventilated (unless there's a fitting in the sleeve), but local building officials might.

May CSST be installed directly to a gas meter? Yes, but the gas meter should be supported by the building or other independent support and not only by piping.

May CSST be run through masonry and concrete? Yes, but it should be run through a water-tight, non-metallic sleeve that is at least $\frac{1}{2}$ inch larger than the CSST. The sleeve should be sealed.

Bonding CSST

For those who have just returned from being stranded on a desert island, here's a news flash: There are special bonding requirements for most CSST. A copper bonding conductor #6 or larger should be attached using a listed clamp at the first length of hard pipe after the gas meter, or at the first CSST fitting. The bonding conductor should run to the grounding connection at the service equipment, the grounding electrode, or the grounding electrode conductor. This bonding is for lightning protection, not for personnel protection, which is the reason for bonding most other metal.

There are a couple twists to this bonding requirement. One is that Gastite FlashShield brand CSST is not required to be bonded beyond the normal bonding required of all metal gas pipes. The building official may require bonding FlashShield anyway, but Gastite doesn't. The other twist is that this bonding requirement is relatively recent. Older CSST installations may not be bonded according to current requirements and, as the general rule goes,

existing installations need not be improved to current requirements. Still, it's a good idea to report CSST that isn't bonded as currently required and warn clients of the fire risk.

Flexible Appliance Connector (FAC) Inspection

FAC are a good and easy way to connect gas piping to gas appliances. In fact, they are sometimes required in places like earthquake country because they are less likely to break if the appliance moves during the shaking. There are, however, limits to how and where they may be installed. Here are some of the most frequently abused limits.

1. A shut-off valve should be at or very near the FAC.
2. Two or more FAC should not be connected to each other (See Picture 2).
3. Bends with a radius smaller than 1½ inches (See Picture 4 and Figure 1) are not allowed, nor are right-angle bends.
4. Tightly stretched FAC are not allowed (See Picture 3). You should be able to move the FAC at least 2 inches.
5. FAC may not be run into appliance cabinets or through walls, floors and ceilings.
6. Some FAC may not be listed for use with high-pressure gas service (> ½ psi.); check the tag on the FAC if it's still attached.

7. Most FAC are designed for occasional movement. Use with LP tank bottles and appliances that will be moved frequently is not allowed.

Most FAC are listed for above-ground outdoor use. Most manufacturers, however, do not recommend FAC installation around potentially corrosive chemicals such as chlorine and ammonia. Use at a swimming pool heater and storage of harsh chemicals near a FAC may be questionable.

The Bottom Line

CSST and FAC can look similar, so some confusion by newer inspectors is understandable. They are not the same and it's important to know the differences and how each should be installed.

Memo to Vulcan (god of fire): The Word does not reside on Mt. Olympus (just at its base) and welcomes other viewpoints. Send your lightning bolts or emails to Bruce@DreamHomeConsultants.com. The thoughts contained herein are those of The Word; they are not ASHI standards or policies. ■



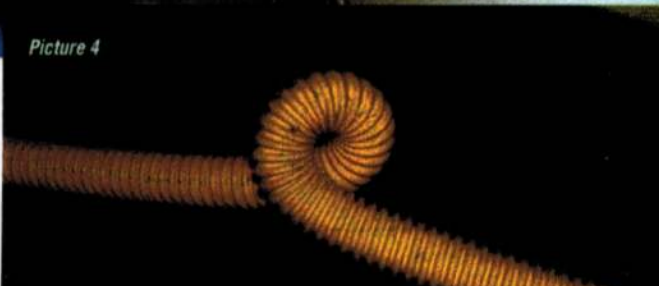
Bruce Barker operates Dream Home Consultants. He has been building and inspecting homes since 1987. He is the author of "Everybody's Building Code" and currently serves as chair of the ASHI Standards Committee. To read more of Barker's articles, go to www.dreamhomeconsultants.com.



Picture 2



Picture 3



Picture 4