

## Concerns About CSST Gas Lines - "Grounded" in Reality?

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In traditional construction practice, natural gas and liquid propane (LP) were transmitted through an occupied structure only through rigid black iron pipe with threaded and sealed fittings. More recently, it has become common practice to use corrugated stainless steel tubing (CSST) for gas lines in residences and commercial buildings. This gas line is flexible and usually easily identifiable by its yellow exterior plastic coating. The reasons for CSST's popularity all relate to simple economics—the CSST product is less expensive, and requires far less time and skill to install.

CSST's main attribute is its flexibility. It can be bent and conformed by hand, allowing gas pipe to be installed much like pulling electrical wire. Some have estimated that installation of CSST saves as much as 75 percent of the time required to installed black iron pipe. CSST cuts easily with a standard tube cutter, and requires no threading or welding, and no special tools to seal the fittings. CSST gas line also weighs far less than rigid gas pipe, and is less bulky to store, transport, and handle. During the installation process, the flexible CSST product can make turns without the need for installing threaded and sealed pipe elbows.

- CSST is much less expensive to install than black iron gas pipe, and as a result, CSST has been installed in millions upon millions of homes across the U.S.
- The real problem: CSST is so thin-walled that it creates a significant fire hazard anywhere it is installed.

CSST gas line is extremely thin, with walls typically around 0.008" in thickness. Black iron gas pipe is typically 0.12" in thickness. Put another way, the walls of black iron pipe are 15 times thicker than the walls of CSST tubing. When this is considered, perhaps it is not surprising that the amount of electrical energy needed to defeat traditional black iron pipe is about 15 times more than the energy needed to defeat the much thinner walls of CSST tubing.

When electrical energy from lightning is conducted through CSST tubing, electrical arcing can be created between the CSST and any grounded metallic object, as the lightning energy seeks a ground source. This arcing can instantaneously burn a small hole, ranging from the size of a pin-head to a pencil eraser, right through the very thin wall of the CSST. The arcing event can easily ignite the escaping gas being carried by the CSST, which can then serve as a blow-torch with an endless gas fuel source more than sufficient to ignite nearly any type of structure.

Lightning strikes the United States more than 25 million times each year and according to Underwriters Laboratories (UL), lightning accounts for more than \$1 billion in annual structural damage. A single bolt of lightning can carry over 100 million volts of electricity, and in reality, there are no construction methods or safety measures that can completely protect a

structure from a direct lightning strike. CSST gas pipe, however, is susceptible to damage from non-direct lightning strikes as well, even strikes which may be recorded a significant distance away from the structure. “Lightning does not have to strike a building directly in order for the CSST to be affected,” explains Guy Maxwell, president of the Lightning Safety Alliance. “The reports of CSST related fires that I have seen have involved strikes that were near the structure.”

CSST was originally developed in the late 1980s, but most CSST product has been installed since 2003. Any building that has had natural gas piping work done since 1990 could have CSST installed. According to the National Fire Protection Association (NFPA), no tests on the effects of lightning on CSST were conducted prior to its approval for use. One CSST manufacturer has acknowledged that the installation of a lightning protection system addresses the lightning hazard associated with CSST, yet homes with CSST are rarely equipped with lightning protection systems.

A Class Action Lawsuit against four CSST manufacturers has identified the installation of a lightning protection system and/or bonding and grounding connections as the remedies for the fire risk associated with CSST. In March 2007, the four defendants in the Class Action suit filed in the Circuit Court of Clark County Arkansas reached a settlement. Under the settlement guidelines, vouchers for lightning protection systems or bonding were provided to defray the cost of mitigating the CSST hazard. Unfortunately, the class-action deadline to enter a claim under the Settlement closed on September 5, 2007, leaving property owners responsible for their own fix if they have a CSST gas system.

Insurance industry sources report a dramatic increase in the cost of homeowners’ claims for damage due to lightning strikes—citing costs up at least 20 percent since 2004. “Unfortunately, there hasn’t been enough publicity given to the lightning hazard associated with CSST,” said Bud VanSickle, executive director of the Lightning Protection Institute (LPI) in Maryville, MO. “Even though the class action deadline has closed, there are still millions of property owners out there with a serious fire risk that needs to be addressed.

- In many CSST installations, the CSST tubing is not bonded to a ground, which is a violation of the manufacturers’ current installation instructions, which require that the gas system be directly bonded to the electrical system’s grounding system with 6 AWG copper wire, near the service entrance to the building. A failure to bond the system according to the manufacturer’s instructions may or may not be a violation of the National Fuel Gas Code (NFGC), the National Electrical Code (NEC), or local building codes. Although there has been much discussion about rewriting the bonding provisions in those codes, this will not be done at least until the next code cycles, which are due out in 2009 and 2011, respectively.

- CSST brands include:
  - Wardflex
  - Gastite
  - TracPipe
  - Parflex
  - Pro-Flex
  - Diamondback
  
- One manufacturer, Omegaflex, has developed a CSST product called “Counterstrike” which is specifically designed to dissipate the energy from electrical arcing by enclosing the flexible tubing with a proprietary jacket (which is black in color) that is made from a material which is both thicker and conductive. Supposedly, this product will spread the electrical energy over the entire length of the run, allowing it to dissipate rather than concentrate at any one point on the CSST. In theory at least, this should reduce the potential for breaching of the gas line during instances where the CSST is energized by a lightning strike. Despite this attempt to improve the design, bonding to a ground is still required according to Counterstrike’s installation instructions.
  
- Anytime a fire occurs in a structure where CSST is present, the fire investigators should carefully check all CSST runs for leaks. Although blow-out holes from electrical damage are often easily identified visually, a leak test should be performed to confirm the condition of the gas line system.
  
- Keep in mind that stainless steel has a fairly high melting point. If a hole is found in CSST, there is a good chance the hole was caused by lightning. Lightning activity is tracked and available through various sources, including Strike Fax reports. Remember that the lightning strike does not need to be a direct hit to the structure. Strikes that are several miles away can still potentially cause CSST failures.
  
- Fire claims which are related to CSST failure have significant subrogation potential. However, this potential may be limited by the class-action settlement with four CSST manufacturers mentioned above. It also may be limited by new developments in research regarding CSST, which may indicate that the new bonding requirements may not be sufficient to protect the CSST from sustaining a breach during a lightning event.

### Minimum Electrical Bonding and Grounding

Lightning is a known highly destructive force. In the event of high energy from a lightning strike (which can be a direct strike or an indirect strike to nearby objects), CSST can momentarily be at a much higher or lower electrical potential than adjacent metal systems in the building such as heating ducts, copper pipes and wire and telecommunication wires. If this occurs, an electric spark may arc between the CSST and adjacent metal systems. This arcing can melt holes and cause leaks in the CSST.

According to the National Fuel Gas Code NFPA 54/ANSI Z223, “each above ground portion of a gas piping system which is likely to become energized shall be electrically continuous and bonded to a designed, permanent, low-impedance effective ground fault current path.” Parker requires that every above ground portion of the Parflex CSST System is electrically bonded and grounded in accordance with NFPA 70 (NEC® Section 250).

A permanent electrical connection to the earth must be made by bonding the CSST to the grounding system through the use of a bonding clamp and wire in accordance with the National Electric Code, Section 250 (NFPA 70). This bonding point must be in as close proximity to the electrical panel as possible; close proximity of the bonding point to the gas meter is also desirable if possible. The wire gauge for bonding must be sized, at a minimum, for the full amperage available through the electrical service (per NEC®) and no smaller than a 6 AWG copper wire. Bonding clamps used on the The Parflex System must be attached to a Parflex brass fitting (Figure 1), a steel manifold (Figure 2) or to a rigid pipe component connected to a Parflex fitting. The CSST portion of the gas piping system must not be used for the bonding attachment (Figure 3). CSST also must not be used as a grounding electrode or as the grounding path for appliance or electrical systems. The latest edition of the National Electric Code (NEC®) should be consulted for additional requirements and specific techniques for equipotential bonding and grounding.

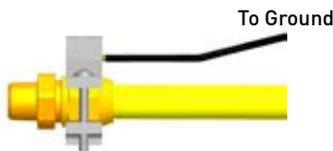


Figure 1: Proper bond attachment on fitting

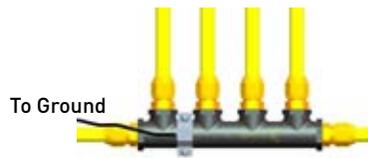


Figure 2: Proper bond attachment on manifold



Figure 3: Unacceptable bond attachment on CSST

CSST must be routed as far as possible from all conductive materials in the building such as metal ducts, metal water pipes and electrical wires and cables. See Figure 4

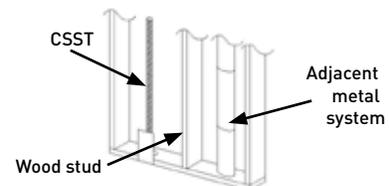


Figure 4: Routing CSST as far as possible from adjacent metal systems. Bonding and Grounding of adjacent metal is recommended.

### Additional Recommended Equipotential Bonding

Equipotential bonding consists of making a low impedance electrical connection between the CSST and any adjacent metal structures to create a uniform electrical potential. Adjacent metal systems can include but are not limited to appliances, metal vents, flues, electrical wires and metal pipes. Bonding and grounding of all electrically conductive metal systems and metallic structural material is recommended.

In order to further increase protection of an entire building structure from potential lightning damage, the installer and user should consider the installation of a lightning protection system pursuant to NFPA 780 or other recognized standard, particularly those in geographical areas prone to lightning strikes.