



TOWNSHIP OF CRANFORD BOROUGH OF GARWOOD



CSST BONDING INFORMATION

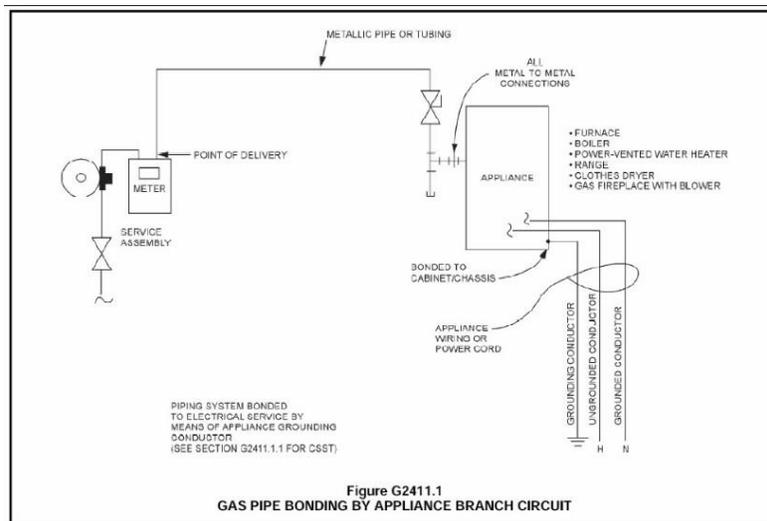
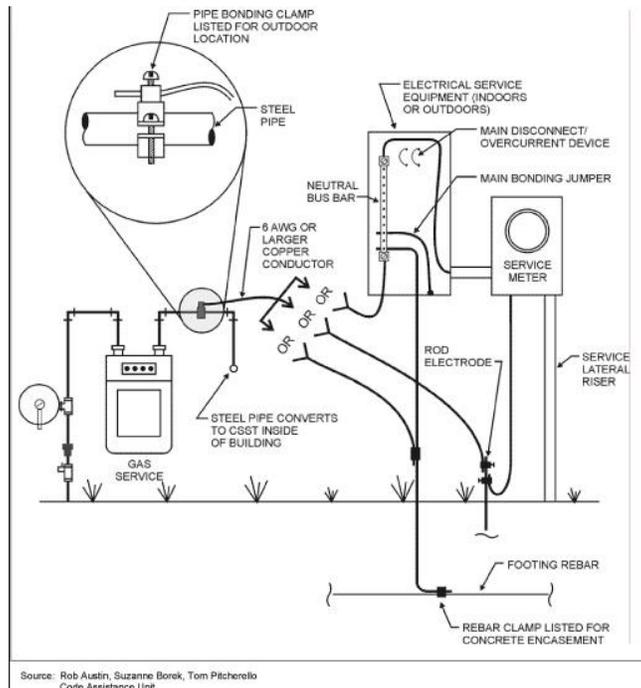
2015 International Fuel Gas Code, Section 310 – Electrical Bonding

310.1.1 CSST. Corrugated stainless steel tubing (CSST) gas piping systems shall be bonded to the electrical service grounding electrode system at the point where the gas service enters the building. The bonding jumper shall be not smaller than 6 AWG copper wire or equivalent.

- ❖ This section addresses gas pipe bonding specific to CSST and does so for the purpose of lessening the possibility of damage to the CSST caused by the electrical energy created by indirect lightning strikes.
- ❖ It is assumed that nothing is capable of fully protecting anything subjected to a direct strike by lightning because of the extremely high energy levels involved and unpredictability of the paths of flow. It is more common for building components to be energized by nearby lightning strikes to the earth, trees, poles, towers, etc. This intense electrical energy can travel through the earth or other objects and energize gas piping systems, among other metal systems and components. This can happen by simple conduction to the piping or by induction through forms of magnetic field coupling. The electrical energy can travel along a pipe or tube and unpredictably jump off and onto another metal pipe, wire or object. This “jumping off” point will experience an arc that has enough energy to burn through a pipe, tube or connector wall. The resulting exit wound caused by the arcing is a perforation that will result in gas leakage and possible a fire or explosion. This damage can happen to any piping material, including steel pipe, CSST and copper tube, and also gas connectors. Relatively recent experience has shown that CSST is susceptible to this type of lightning damage and this section intends to mitigate the possibility of such damage.
- ❖ Recall that the CSST piping will already be bonded to some degree by the appliance grounding conductor(s)...assuming that it is connected to appliances that are electrically powered. This bonding however, is not considered to be adequate to protect CSST, therefore Section 310.1.1 mandates a more effective bonding means. Directly bonding the CSST piping to the electrical service grounding electrode system has been shown by laboratory experiments to substantially reduce the risk of lightning damage. The minimum size bonding jumper was chosen based on the maximum size of grounding electrode conductor that is required to connect to “made” electrodes such as ground rods and plates as addressed in the NEC (NFPA 70). A number 6 AWG copper bonding jumper provides an electrical path with considerably less impedance than the typical equipment grounding conductor found in an appliance branch circuit. This section assumes that the gas service and electrical service will be in close proximity thus allowing for a shorter bonding jumper, which also enhances its performance. The intent is to make the bonding jumper as short as possible to minimize impedance. Also, bonding will hopefully bleed off the earth any stray voltage before it energizes the pipes in the building and causes arcing. It is still being debated and studied as to where to connect the bonding jumper in cases where the electrical service and gas service are not in close proximity.
- ❖ The requirement of this section is also a requirement in the manufacturer’s installation instructions for most CSST products. Note that some manufacturers are marketing special

types of CSST that have jackets specifically designed to conduct electrical energy as a means of protecting the stainless steel tubing. The provisions of Section 310.1.1. apply regardless of any manufacturer's statements to the contrary because currently, the code does not recognize alternatives to the bonding prescribed herein; however, the code official could approve an alternative to the bonding requirements of this section in accordance with the authority granted in 105.2

- ❖ As stated in the manufacturer's instructions, the bonding clamp must connect only to rigid steel pipe or a brass CSST fitting and it must never connect directly to the tubing itself. Clamping directly to the corrugated tubing would result in a poor electrical connection and could promote failure from the current flow at that location. Bonding clamps must be listed for the application, for example, clamps used outdoors must be a type identified for outdoor use. The typical installation will have Schedule 40 steel pip extending from the point of delivery (typically the meter outlet) and passing through the outside wall into the building for some distance. The bonding clamp will be attached to this steel pipe either indoors or outdoors, immediately next to the building penetration.



Construction Code Communicator



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Department of Community Affairs
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Electrical Bonding of CSST Gas Piping Systems

There has been some confusion as to whether Section 310.1.1 of the International Fuel Gas Code (IFGC)/2009 and Section G2411.1.1 of the International Residential Code (IRC)/2009 are in direct conflict with Section 309.1 and Section G2410.1, respectively, of the same codes, along with Section 250.104(B) of the National Electrical Code (NEC)/2008. We believe the confusion lies in the words of Section 309.1 (IRC)/G2410.1 (IFGC) as follows: "Gas piping shall not be used as a grounding electrode." In short, bonding the gas CSST piping system does, by default, make it part of the electrical service grounding electrode system, it however is not being *USED* as the grounding electrode.

The IRC/2009 and IFGC/2009 state:

"G2411.1.1 (310.1.1) CSST.

Corrugated stainless steel tubing (CSST) gas piping systems shall be bonded to the electrical service grounding electrode system at the point where the gas service enters the building. The bonding jumper shall be not smaller than 6 AWG copper wire or equivalent."

The purpose of the bonding jumper required by these sections is to reduce the likelihood of damage to the CSST caused by the electrical energy from an indirect

Electrical Bonding

continued from left

lightning strike. As you know, NOTHING is capable of protecting ANYTHING from a direct lightning strike. In the case of an indirect strike, the electrical energy could travel along metal piping and tubing and "jump" off to other metal components in the building. This causes an arcing that could burn and perforate the wall of CSST tubing due to the lack of thickness of its exterior wall thus causing a gas leak. Per the IRC/2009 Commentary, the bonding of the CSST directly to the electrical service grounding electrode system has been shown in laboratory testing to greatly reduce this risk. Remember that the bonding clamp must connect to the rigid steel piping at the point where the gas service enters the building and may be located either inside or outside the building. The bonding conductor must be continuous with the other end connected to the steel enclosure of the electrical service equipment or the grounded conductor at the electrical service or the grounding electrode conductor (if of sufficient size) between the service equipment and the grounding electrode(s) or one or more of the grounding electrodes for the electrical system. The bonding jumper may be connected as per the diagram below. The diagram is a reprint, with permission from the International Code Council (ICC), from the IRC/2009 Commentary. As you can see, ICC Commentaries provide wonderful insight into the intent of the code provisions and are a useful tool in any code official's library.

See Electrical Bonding at right

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CSST Gas Pipe Bonding Requirements

The responsibility for plan review and inspection for these code sections from the IRC and IFGC are assigned to “electric/electric” in N.J.A.C. 5:23-3.4 of the Uniform Construction Code.

This means that an electrical technical section is required and must be signed and sealed by a licensed electrical contractor as per N.J.A.C. 5:23-2.15(b)2ii of the UCC, unless the installation is by a homeowner in their own single family dwelling as per N.J.A.C. 5:23-2.15(b)2i.

The attached of the 6 AWG copper conductor should be attached on the metallic gas pipe between the meter and the building ahead of any CSST gas pipe connections.

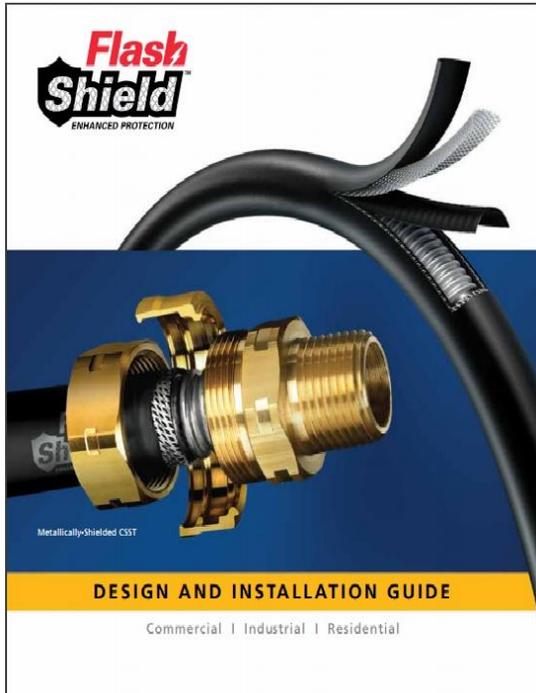
The 6 AWG copper conductor is permitted to be connected to an existing ground rod on the premise or the conductor going to that ground rod; OR the 6 AWG copper conductor is permitted to be connected to the rebar grounding electrode or connected to the 4 AWG copper conductor which is attached to the rebar.

The final option, one not recommended, but meets the requirements of the above sections, would be to connect the 6 AWG copper conductor to the grounding termination within the panel board.

Again, this does not come from any NEC code sections, just the IRC and IFGC.

Where a ground rod has been installed at the gas meter in an attempt to meet the above requirements, then the National Electrical Code (NEC) becomes involved due to the installation of a grounding electrode now being present on the premises.

Section 250.50 of the 2014 NEC states that all the items in 250.52(A)(1) through (7) where present at each building or structure served shall be bonded together. By this section of the NEC, the newly installed ground rod at the gas meter would now be required to be bonded to the grounding electrode system, which means the ground rod could now be bonded to any of the electrodes listed in Section 250.52(A)(1) through (7). That would be an existing ground rod, rebar, building steel, water pipe, etc.



Important Lightning Safety Warning

LIGHTNING SAFETY WARNING

- PROPERLY BONDING** and grounding the Corrugated Stainless Steel Tubing (CSST) system may reduce the risk of damage and fire from a lightning strike. Lightning is a highly destructive force. Even a nearby lightning strike that does not strike a structure directly can cause systems in the structure to become electrically energized. Differences in potential between systems may cause the charge to arc between systems. Such arcing can cause damage to CSST, including holes. Bonding and grounding should reduce the risk of arcing and related damage. The building owner should confirm that a qualified contractor has properly bonded the CSST gas system to the grounding electrode system of the premises. Refer to Section 4.10 Electrical Bonding/ Grounding in the Gasite Design & Installation Guide for details on bonding & grounding CSST.
- ALL OWNERS** should consult a lightning safety consultant to determine whether installation of a lightning protection system would be required to achieve sufficient protection for all building components from lightning. Factors to consider include whether the area is prone to lightning. Areas with high lightning risk include but are not limited to: Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, New Mexico, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia and West Virginia. One currently available source of information regarding areas more prone to lightning than others is the flash density map provided by the National Weather Service which can be found at http://www.lightningsafety.noaa.gov/lightning_map.htm. Lightning protection systems are beyond the scope of this manual and installation guidelines, but are covered by National Fire Protection Association, NFPA 780, the Standard for the Installation of Lightning Protection Systems, and other standards.
- THE OWNER** should confirm with the local gas supply utility company that a suitable dielectric union is installed at the service entry of the structure between underground metallic piping and the gas pipes going into the building as required by code.
- NATIONAL ELECTRIC CODE (NEC)**, Section 250.104b, states that "bonding all piping and metal air ducts within the premises will provide additional safety." Gasite recommends that all continuous metallic systems be bonded and grounded. The owner should confirm with an electrical or construction specialist that each continuous metallic system in a structure has been bonded and grounded by an electrical professional in accordance with local building codes. This should include, but is not limited to metallic chimney liners, metallic appliance vents, metallic ducting and piping, electrical cables, and structural steel.
- DIRECT CONTACT** between continuous metallic systems and Gasite® yellow CSST is prohibited. Maintain as much isolation/separation as reasonably possible when planning and installing gas piping from other continuous metallic systems. Refer to sec. 4.3 Bonding in the Gasite D&I Guide for installation techniques. Consult local building codes as to required separations for CSST from such continuous metallic systems including metallic chimney liners, metallic appliance vents, metallic ducting and piping, and insulated or jacketed electrical wiring and cables. See for instance the Indiana Residential Code, section 875 IAC 14-4.3-155.5 Section G2411.1; gas pipe bonding.
- LOCAL BUILDING CODES** are controlling, however, as a general practice, full gas piping, including CSST, should not be installed within a chase or enclosure that houses a metallic chimney liner or appliance vent that protrudes through the roof. In the event such an installation is necessary and conforms to local building codes, the metallic chimney liner or vent must be bonded and grounded by a qualified electrical professional, and a separation distance, as specifically permitted by the applicable local building code between the CSST and the metallic chimney liner or vent, is required. Physical contact between CSST and the metallic chimney liner and/or vent is prohibited. If this physical separation cannot be specifically identified in the local building code and achieved or any local building code requirements cannot be met along the entire length, then rerouting of the CSST is required unless such installation is specifically permitted by the local building inspector.

Gasite
The System is the Solution™

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GENERAL USE/15



ERITECH™

Features

- Ideal for connecting copper conductors to metallic water pipe (including copper tubing) or ground rods
- Bond corrugated stainless steel tubing (CSST) or flexible gas pipe systems to the electrical system in accordance with the National Fuel Gas Code (NFGC) and the National Electrical Code® (NEC)
- Applications include lightning protection, fault current ground, signal reference grid and static ground
- CWP series of clamps fits hex fittings, copper grounding conductors, galvanized water pipes, copper water tubing or copper ground rods ranging from 1/2" to 4"
- High-strength silicone bronze clamps connect brass hex fittings
- UL® Listed (ANSI/UL 467 - Category KDER)

Pipe Clamps For Water or Flexible Gas Pipes



The UL® Listed CWP Grounding Clamp from ERICO® connects brass hex fittings, copper grounding conductors, galvanized water pipes, copper water tubing or ground rods to a ground conductor to bond all ground points together, eliminating ground loops and creating an equipotential plane. Part of the ERITECH® line of Facility Electrical Protection products, this clamp allows the ground conductor to dissipate energy into a low-impedance grounding system to help protect the facility, equipment and personnel when lightning or other transient voltages occur.

Flexible Gas Pipe Brass Hex Fitting to Bonding Sizing			
Bonding Clamp	Nominal Pipe Size	Hex Fitting	
Part Number		Hex Nut Size	Hex Nut Size
CWP1J	3/8"	1	1 1/4"
	1/2"	1 1/2"	1 3/8"
CWP2J	3/4"	1 1/2"	1 3/8"
	1"	2	2 1/8"
CWP3J	1 1/4"	2 1/2"	3 1/8"
	2"	3	3 1/8"

Part Number	Pipe Size	Conductor Size	Hex Nut Size (in) [Min]	Hex Nut Size (in) [Max]
CWP1J	1/2 in - 1 in	10 Sol - 2 Sol	1 in	1 1/4 in
CWP2J	1 1/4 in - 2 in	10 Sol - 2 Str	1 1/2 in	2 1/8 in
CWP3J	2 1/2 in - 4 in	10 Sol - 4 Str	2 1/2 in	3 1/8 in

Material: Bronze



WARNING
ERICO products shall be installed and used only as indicated in ERICO product instruction sheets and training materials. Instruction sheets are available at www.erico.com and from your ERICO customer service representative. Improper installation, misuse, misapplication or other failure to completely follow ERICO's instructions and warnings may cause product malfunction, property damage, injury and death.

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