



# Borough of Roselle Park

## CSST Bonding Information

### *2015 International Fuel Gas Code, Section 310 – Electrical Bonding*

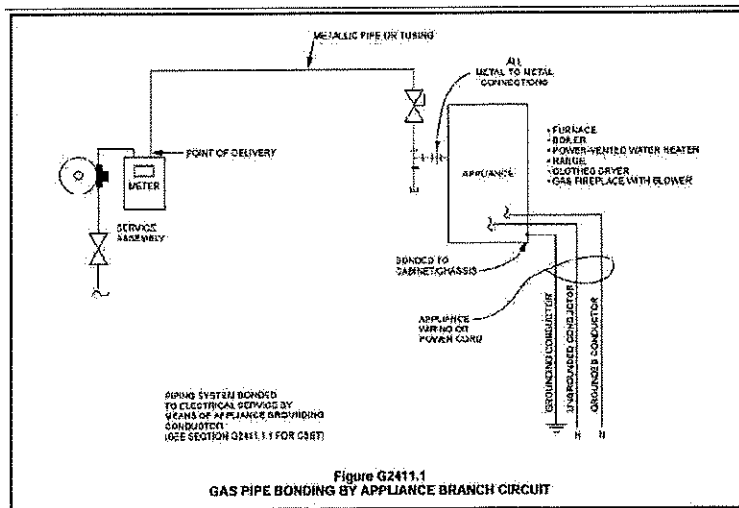
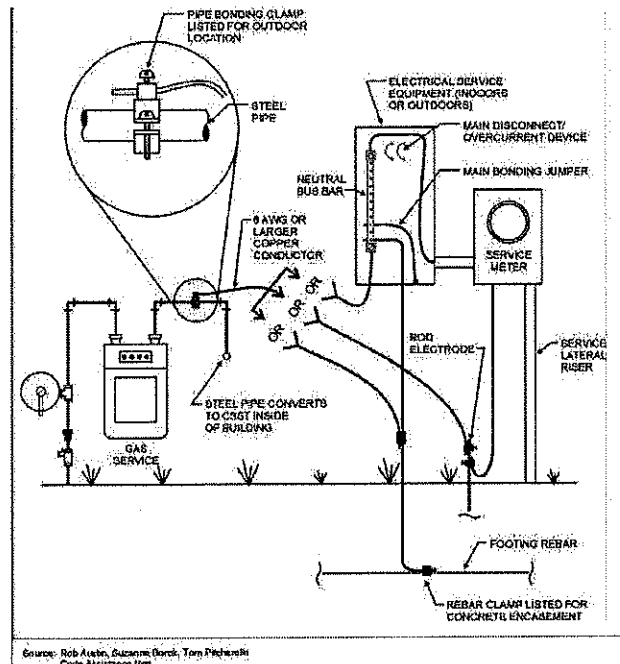
**310.1.1 CSST.** Corrugated stainless steel tubing (CSST) gas piping systems shall be bonded to the electrical service grounding electrode system at the point where the gas service enters the building. The bonding jumper shall be not smaller than 6 AWG copper wire or equivalent.

- ❖ 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

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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 od 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.*

*See Electrical Bonding - page 11*

## **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.

# Flash Shield

ENHANCED PROTECTION



Metallically-Bonded CSST

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## DESIGN AND INSTALLATION GUIDE

Commercial | Industrial | Residential

## Important Lightning Safety Warning

**LIGHTNING SAFETY WARNING**

**1. PROPERLY BONDING** and grounding the Corrugated Stainless Steel Tubing (CSST) systems 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 failure. 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 per system to the grounding electrode system of the premises. Refer to Section 4.19 (Electrical Bonding/ Grounding) in the Gas Safe Design & Installation Guide for details on bonding & grounding CSST.

**2. ALL OWNERS** should consult a lightning safety contractor to determine whether installation of a lightning protection system would be required by authority and what 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 Arkansas, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Mississippi, Michigan, Minnesota, Missouri, New Mexico, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia and West Virginia. See currently available notices of warnings regarding areas prone to lightning that address the Flash Shield system provided by the National Weather Service, which may be found at [http://www.lightning-quarter.com](http://www.lightningquarter.com). 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.

**3. THE OWNER** should confer with the local gas supply utility company that a suitable electrical system is installed at the service entry of the structure between meter ground and electric piping and the gas pipe going into the building as required by code.

**4. NATIONAL ELECTRIC CODE (NEC)**, Section 501.104, states that "bonding all piping and metal structure within the premises is required for additional safety". Gas Safe recommends that all continuous metallic systems be bonded and grounded. The owner should confer with an electrical contractor who specifies that each continuous metallic system in a structure has been bonded and grounded by an electrical professional or an electrician with local building codes. This should include, but is not limited to metal fire chimney liners, metallic appliance vents, metal ducting and piping, electrical cables, and structural steel.

**5. DIRECT CONTACT** between continuous metallic systems and electrically energized CSST is prohibited. Prohibit any such contact, regardless of risk level by permitting appropriate bonding and grounding gas piping from other continuous metallic systems. Refer to sec. 4.2 (Bonding) in the Gas Safe Design Guide for installation techniques. Consult local building codes for any required separations for CSST from such continuous metallic systems, including metal chimney liners, metallic appliance vents, metallic ducting and piping, and installed as follows: Electrical bonding and electric fire protection. See the National Electrical Code, section 761.14C(3)-4.3-15.3 Section 761.1.4, gas pipe bonding.

**6. LOCAL BUILDING CODES** are controlling; however, as a general practice, local gas piping, including CSST, should not be installed within an attic or sub-attic that houses a metallic chimney liner or appliance vent that penetrates through the roof. At the point such an installation is necessary and necessary to the local building code, the metallic chimney liner or vent must be bonded and grounded by a qualified electrical professional, and a separate clearance, 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 vent is prohibited. If this physical separation cannot be specifically identified in the local building code and satisfied in any local building code, separate records cannot be used along the entire length. The bonding of the CSST is required unless such installation is specifically permitted by the local building inspector.

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## ERITECH

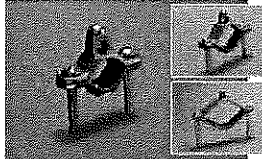
Features

- 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 (NFPA 54) 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 silicon bronze clamps connect brass hex fittings
- UL® Listed (ANSI®) UL 467 - Category KDER



## Pipe Clamps

For Water or Flexible Gas Pipes

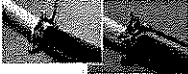


The UL® Listed CWP Grounding Clamp from ERITECH® connects brass hex fittings, copper grounding conductors, galvanized water pipes, copper water tubing or ground rods in a ground conductor to bond all ground points together, eliminating ground loops and creating an equipotential plane. Part of the ERITECH®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

Bonding Clamp	Hex Fitting	
	Nominal Pipe Size	Max. Pipe Size
CWP1	1/2"	1 1/4"
	3/4"	1 3/4"
CWP2	1"	1 5/8"
	1 1/4"	2 1/8"
CWP3	1 3/4"	2 3/4"
	2"	3 1/8"

Part Number	Pipe Size	Conductor Size	Hex Nut Size (in.) (Metric)	Hex Nut Size (in.) (Metric)
CWP1	1/2 in - 1/2 in	10 Sol - 2 Sol	1 in	1 1/2 in
CWP2	1 1/4 in - 2 in	10 Sol - 2 Sol	1 1/2 in	2 1/8 in
CWP3	2 1/4 in - 4 in	10 Sol - 4 Sol	2 3/8 in	3 1/8 in

Material: Bronze



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