



STATE OF NEW HAMPSHIRE DEPARTMENT OF SAFETY

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TECHNICAL BULLETIN AND APPLICATION OF THE CODE ON CORRUGATED STAINLESS STEEL TUBING (CSST) JULY 1, 2009

The State Fire Marshal is issuing this technical bulletin on the installation of Corrugated Stainless Steel Tubing (CSST) to provide pertinent information for consideration before designing, installing, or inspecting CSST products. This technical bulletin replaces the technical bulletin issued on October 27, 2006, which was specific to the technical bulletin, "TB2006-04" issued by the Gastite Division of the Titeflex Corporation.

There have been many questions and concerns that have been brought to the attention of and generated by the Electrical and Mechanical Sections of the State Fire Marshal's office. This technical document is being assembled to identify and provide clarity, where possible, to the issues related to installing and bonding CSST.

With regard to bonding of CSST, there are three general considerations. They are the requirements of NFPA 54, the Natural Fuel Gas Code; the requirements of NFPA 70, the National Electrical Code and the manufacturer's requirements.

The Fuel Gas Code

NFPA 54, the Natural Fuel Gas Code, offers general criteria for the installation and operation of gas piping and gas equipment on consumers' premises. Under Saf-C 6009.01, (a) of the State Fire Code, the 2002 edition of NFPA 54 is adopted in New Hampshire. The State Fire Marshal recognizes that newer editions are available, the 2006 and 2009 editions, neither of which is applicable in New Hampshire at this time unless there has been some adoption action at the local level.

The 2002 edition of NFPA 54 simply states that the gas piping has to be bonded to any grounding electrode as defined in the National Electrical Code without any prescriptive measures.

The 2006 edition of NFPA 54 is more specific and basically mirrors the language in the National Electrical Code. Section 7.13 states that "each aboveground portion of a gas piping system that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping shall be considered to be bonded when it is connected to appliances that are connected to the equipment grounding conductor of the circuit supplying that appliance."

In the 2009 edition of NFPA 54, the technical committee accepted comments that revised 7.13 to include 2 categories of gas piping. Section 7.13.2 will cover pipe and tubing other than CSST and a new section, 7.13.4, will cover CSST. This new section states “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 not be smaller than 6 AWG copper wire or equivalent.” Reference to this code is found in many of the CSST manufacturer’s current installation instructions or by industry related Technical Bulletins.

All three NFPA 54 versions address CSST through similar language. In Chapter 4, section 4.1 mandates that the installation, testing and replacement of gas piping, gas utilization equipment, and accessories, and repair and servicing of equipment, be performed by a qualified agency. These qualifications come from various forms of state licensing programs, industry approved training courses and specified manufacturer’s training or certification classes as well as continuing education programs required to stay current with changes in industry standards.

The Fuel Gas Code mandates through 5.6.3.4 in both the 2002 and 2006 versions that; “Corrugated Stainless Steel tubing shall be tested and listed in compliance with the construction, installation, and performance requirements of ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing.*”

In the 2002 version the Technical Committee recognized that the CSST industry was growing in popularity by and included excerpts from the ANSI standard as a supplement in the Handbook version of the 2002 National Fuel Gas Code.

Paragraph 5 recognized that; “Although the tubing and fittings are components, the ANSI LC 1/CSA 6.26 standard requires that CSST be sold as a system. Other necessary components to be used within the overall system include; multiport manifolds, appliance termination outlets, metallic striker plates....”

Paragraph 6 stated; “The CSST manufacturer is also responsible for preparing and distributing a set of design and installation instructions, as well as the training of all installers. The installation instructions must be revised and reprinted as needed and in the trained installers kept abreast of all pertinent changes to the hardware, installation practices or sizing methods.”

The NFPA permitted the installations of fuel gas piping systems using CSST listed in accordance with the requirements of ANSI/AGA standards. Regardless of which adopted year of the Fuel Gas Code used in New Hampshire, the CSST industry has been bound by the listing standards to continually upgrade, notify and train their installers as to the changing requirements for the safe use and installation of their product. The recent changes in the bonding of CSST systems for lightning protection fall under these revisions with the most recent listings.

The Electrical Code

The edition of the National Electrical Code (NFPA 70) currently adopted by the State of New Hampshire is the 2008. Section 250.104 covers bonding of piping systems and exposed structural steel. Section 250.104(B) covers the bonding of metal piping systems, including gas piping, that are likely to become energized and are installed in or attached to a building or structure. As noted in the commentary in the NEC Handbook, what “likely to become energized” means is that where metal piping systems and electrical circuits interface through mechanical and electrical connections within equipment, a failure of electrical insulation can result in the connected piping system(s) becoming energized. With that thought in mind, it is our opinion that the “circuit that is likely to energize the piping system(s)” is the one that is supplying the appliance.

Piping systems covered by 250.104(B) are required to be bonded to the service equipment enclosure, the grounded conductor at the service, the grounding electrode conductor where of sufficient size, or to one or more grounding electrodes used. The bonding jumper(s) shall be sized in accordance with 250.122, using the rating of the circuit that is likely to energize the piping system(s). The equipment grounding conductor for the circuit likely to energize the piping system(s) shall be permitted to serve as the bonding means. Typically, the use of an additional bonding jumper is not necessary to comply with the bonding requirement of 250.104(B) because the equipment grounding connection to the non-current-carrying metal parts of the appliance also provides a bonding connection to the metal piping attached to the appliance.

With no prescriptive bonding methods in the currently adopted in the State of New Hampshire, 250.104(B) in the National Electrical Code (NFPA 70-2008) recognizes the equipment grounding conductor of the circuit that is likely to energize the piping system as providing the bonding required by that section, the burden of properly bonding the CSST piping systems for lightning protection falls squarely on the CSST Manufacturers to comply with industry listings which mandate this additional level of protection.

The National Electrical Code, 250.52(B), and NFPA 54, 7.13.2, both prohibit the underground portion of gas piping as being used as a grounding electrode. Essentially, this means that a dielectric fitting must be provided to isolate the underground metal gas piping from the aboveground portion of the system. Additionally, no bonding jumper can be connected to the underground portion of the piping.

The Manufacturer's Requirements

The Manufacturers Instructions repeatedly refer to the proper training of technicians to install their CSST piping systems. While there have been many changes to the product listing, including additional requirements for the proper bonding of CSST for lightning protection, the State Fire Marshal's Office has expressed deep concerns over the continuing education and requalification procedures for CSST Installers. Currently the CSST industry has little if any verification procedures in place that demonstrate any of their previously trained installers have been retrained or certified in the proper bonding procedures and or recent changes in product updates. To compound this problem the State Fire Marshal's Office has observed that there is little enforcement from the industry supply houses that insures only properly certified installers are able to procure the CSST products. The CSST manufacturers must be compelled to work with their local suppliers to develop a distribution program that will insure their product is distributed solely to qualified technicians.

Without providing some type of dated recertification card there is no possible way for building or fire inspection staff to verify the qualification of the installer for any CSST system in New Hampshire. Because of these serious laps in recertification with regards to industry updates, inspectors would have little choice not to permit the installation of this product based on the fact that they could not verify the installer's proper qualifications in accordance with NFPA 54 section 4.1.

The CSST industry must develop and present for consideration an enhanced training and certification program that addresses the following issues;

- Any and all installation procedures along with industry updates and how they will be given to every technician who intends to install their product line.
- A specific CSST bonding protection course that will be offered to building and fire officials, electricians and fuel gas fitters who need additional support and training for this subject.
- Providing specific training regarding product changes, enhancements, and bonding protection of CSST systems in order to remain compliant with NFPA 54 4.1.
- Providing a dated recertification card to all technicians who have successfully passed the exam after course completion. This card will list the date, course content, instructor, and location. In addition, all cards shall be printed with an expiration date not to exceed three years from date of issue.
- Providing a means to insure that technical bulletins and product updates are reaching both industry inspection officials and trade related personnel.

There are currently three types of CSST systems available in the State of New Hampshire. They are, in alphabetical order, “Gastite” from the Titeflex Corporation, “TracPipe” from OmegaFlex and “Wardflex” from Ward Manufacturing. All three manufacturers include specific bonding instructions in the installation guides. The Titeflex Corporation has issued Technical Bulletin “TB2008-1” which replaces “TB2007-01” and updates Section 4.10 on Electrical Bonding/Grounding of the January 2008 Gastite Design and Installation Guide. All of the manufacturer’s specific bonding requirements, including the updated Gastite requirements, are mandatory instructions that must be followed.

“Gastite”

The “Gastite” direct bonding requirements are the most prescriptive. They apply to all their gas piping systems incorporating CSST whether or not the CSST is connected to gas equipment that is electrically powered. The requirements contained in their technical bulletin are intended for single family and multi-family buildings. The technical bulletin states a person knowledgeable in electrical system design, the local electrical code and the specified requirements of the bulletin should specify the bonding for commercial applications.

The CSST gas piping system is intended to be directly bonded to the electrical grounding system of the premise in which it is installed in accordance with the following: The piping is permanently and directly connected to the electrical service equipment enclosure, the grounded conductor at the electrical service, the grounding electrode conductor (where of sufficient size) or to one or more of the grounding electrodes used. For single and multi-family structures, a single bond connection shall be made downstream of the individual gas meter for each housing unit and upstream of any CSST connection. The bonding conductor shall be no smaller than a 6 AWG copper wire or equivalent. The bonding jumper shall be attached in an approved manner in accordance with NEC Article 250.70 and the point of attachment for the bonding jumper shall be accessible. Bonding/grounding clamps shall be installed in accordance with its listing per UL 467 and shall make metal-to-metal contact with the piping.

For attachment to the CSST gas piping system, a single bonding clamp must be attached to either a segment of steel pipe or to a rigid pipe component. The corrugated stainless steel tubing portion of the gas piping system shall not be used as the point of attachment of the bonding conductor at any location along its length under any circumstances.

“TracPipe”

Section 4.10 B of the “TracPipe” installation manual requires the conventional “yellow-jacketed” system to have a bonding clamp attached to the brass “AutoFlare” fitting adapter or to a “black pipe” component (pipe or fitting) that is located in the same electrically continuous gas piping system as the AutoFlare fitting. The bonding conductor is intended to be installed in accordance with the National Electrical Code and sized in accordance with 250.66 and Table 250.66. Under no circumstances is the bonding connection to be made to the corrugated stainless steel tubing portion of the system.

“WARDFLEX”

The “WARDFLEX” Technical Bulletin, WF2008-1, requires direct bonding of all natural and LP gas piping systems incorporating their product whether or not the piping system is connected to an electrically powered gas appliance. A bonding jumper must be permanently connected to the electrical service grounding system. The connection to the grounding system can be made to the grounded conductor at the electrical service, the electrical service equipment enclosure, the grounding electrode conductor where of sufficient size and to the one or more electrodes used. The bonding conductor cannot be smaller than 6 AWG copper, it must be protected in accordance with the National Electrical Code and connected to the gas piping downstream of the utility meter or second stage regulator, but near the gas service entrance. Daisy chained configurations are permitted for multi-meter installations. The listed bonding clamp must be attached to a segment of nonflexible steel pipe or a pipe component such as a nipple, fitting or manifold such that metal to metal contact is made with the steel pipe component.

Observations & Recommendations

The Electrical Safety and Mechanical Sections have done extensive research relative to the use and installation of CSST systems and have generated the following list of observations for consideration.

- In 2008, there have been six known instances where there were failures of CSST piping systems in the State of New Hampshire. The failures resulted from perforations in the CSST caused by arcing from the CSST to adjacent conductive systems.
- Although some of the information presented in CSST industry technical documents alludes to the additional bonding required by the manufactures as being “enhanced ground fault protection,” it is the opinion of the Electrical and Mechanical Safety Sections that the information provided by the CSST industry clearly indicates the additional bonding requirements are related to protection from influences from lightning.
- The State of New Hampshire has requested substantiation from the manufacturers that supports the additional bonding methods specified in their installation instructions. To date, sufficient substantiation has not been provided by the manufacturers to assure the additional bonding measures required in their installation instructions will adequately address the problems associated with the influence of lightning on CSST systems. Some additional concerns are:
 - Assuming the 6 AWG conductor is of adequate size to begin with, how long can it be before the size must be increased? None of the manufacturer’s instructions address this issue directly. However, some recommend involving a knowledgeable person to make that determination.
 - One set of installation instructions only address single and multi-family dwellings. They recommend contacting a “knowledgeable person” with electrical design experience for commercial installations. If the product manufacturer’s testing or an engineering study has not determined an adequate method of bonding for commercial installations, then what criteria would a “knowledgeable person” use to determine a method of bonding that would protect commercial CSST installations from the effect of lightning?

- Another set of installation instructions identify the hexagonal shaped fitting as an acceptable point of attachment for the listed grounding clamp. If the clamp being used is a “pipe clamp” it has likely not been evaluated for use on a hexagonal shaped fitting. Typically, pipe clamps have only been evaluated for use on round pipes.
- One set of installation instructions specifies the bonding conductor is to be sized to the “full amperage of the electric service.” Does this mean the conductor is to be sized based on the main overcurrent device, the size of the service entrance conductors or should it be sized based on the available fault current at the terminals of the service equipment?
- Recent technical documents, other than manufacturers installation instructions, recommend that the 6 AWG bonding conductor be run from the gas piping system to the electrical service grounding system. To accomplish this, the recommendation is to connect the 6 AWG conductor to the electrical service equipment enclosure, the grounded conductor at the service, the grounding electrode conductor where of sufficient size or to the one or more grounding electrodes used. In order for the grounding electrode conductor to be of sufficient size, it must be at least a 6 AWG copper conductor.

Neither the generic installations instructions nor any of the manufacturer’s installation instructions mandate that the 6 AWG copper conductor be connected in the service panelboard, it is only one of the options. As noted above, it could also be connected to the grounding electrode where it is of sufficient size or to the one or more electrodes used. Special consideration must be given to entering into any panelboard, especially one that contains service entrance conductors. Even if the main circuit breaker or fused switch is turned off, in most cases, there will be exposed energized conductors and exposed conductive terminations. Therefore a shock and arc flash hazard will exist. Even qualified persons must use proper personal protective equipment to address the shock and arc flash hazards.

- The CSST industry remains hesitant to address the miles of existing piping systems currently in use in the State of New Hampshire. Without some type of training and notification brochures produced by the CSST industry the State Fire Marshal will have little recourse but to produce an informational campaign to address the safety concerns of the CSST systems currently in use without the benefit of bonding for lightning protection.
- The CSST industry training has raised serious questions as to its validity when qualifying technicians to properly install these piping systems. Rumors of “tailgate training” and self corrected tests have diminished the level of expertise for all installation technicians. The fact that so many industry changes have occurred with respect to the bonding alone lays suspect to the quality of training that technicians have been receiving.

- The CSST industry has not provided any method of recertification and or qualification courses that specifically address bonding or installation upgrades. Building and Fire officials have no way of ensuring themselves that the individual installing the product is indeed properly trained in these methods. Until such time as a dated identification card can be developed, there currently is no way for inspection staff to verify compliance with NFPA 54 section 4.1.

Because of the disconnect between qualifications and training, inspectors could not possibly permit the installation of CSST as they have no way of knowing who has been properly trained by the current standards.

- The distribution of pertinent information with respect to Technical Bulletins, product enhancements, listing upgrades, and industry related changes is extremely flawed. Numerous technical bulletins have never reached installation technicians or inspection agencies leaving large gaps in education and compliance.

Licensing

At the October 28, 2008 meeting the New Hampshire Electricians' Licensing Board (Board) considered the issue of whether an individual must be properly licensed to perform the additional bonding of CSST systems. The Board reviewed the manufacturer's literature, including the installation guides, as well as several technical documents related to CSST installations. The Board unanimously concluded that a license is not required as the additional bonding is a manufacturer's requirement related to the influence from lightning and not a requirement of the National Electrical Code. Because of these facts, it is the Board's opinion that the additional bonding not an installation for heat, light and power and therefore licensing under RSA 319-C is not enforceable. However, this does not prohibit a licensed electrician from performing the additional bonding although consideration should be given to perform this function by attending an approved training course provided by the CSST manufacturer.

Although the Board concluded that the additional bonding of CSST is not included within the scope of RSA 319-C, they expressed concern that the level of competency necessary to perform this installation is that of a licensed electrician and noted that anyone performing the required bonding should have the proper training to adequately and safely perform this task.

Since January 1, 2007 the State of New Hampshire has required that any and all fuel gas piping be installed, serviced and/or demolished by a properly licensed fuel gas fitter. All work pertaining to the installation, testing and maintenance of these systems must be performed by a licensed technician who by code mandate is properly trained and qualified to perform each task. The burden of the technician is two fold. They must be properly licensed through the State of New Hampshire's Mechanical Safety & Licensing program, in addition to having the proper qualifications required to install the CSST system of choice. In the absence of demonstrating either no persons can be permitted to legally install CSST system in New Hampshire.

Both the Electrical and Mechanical Safety Sections of the State Fire Marshal's Office recognize that a licensed electrician is most likely to be the best educated and most skilled tradesmen to perform the task of installing the required bonding jumper for lightning protection of CSST systems. From a professional safety perspective no persons should ever enter any electrical panel without having the proper training and personal protective equipment. It is for these purposes that we recommend that both the qualified CSST installer and the electrician work closely together to accomplish this task.

Bonding Summary

The current edition of the Natural Fuel Gas Code (NFPA 54 2002 edition) does not contain any specific requirements for bonding of CSST, yet recognized the approval of this product provided it conforms to its current listing. As noted above the National Electrical Code (NEC) addresses bonding of gas piping from the perspective of the circuit that is likely to energize the piping. This would be the circuit that is connected to the equipment. Therefore, the bonding for lightning protection is required by the manufacturer's installation instructions in addition to the NEC requirements. Although, in the opinion of the Electrical and Mechanical Safety Sections of the State Fire Marshal's office, sufficient substantiation has not been provided to assure the additional bonding methods are adequate, the specific product manufacturer's installation instructions are mandatory requirements and where CSST is used they must be followed. Any questions related to the installation instructions should be directed to the specific manufacturer. This includes how to install the additional bonding in commercial applications.