Bonding Requirements
For
Gas Piping Systems

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Summary of Presentation

• Why do we bond and ground systems?
• What are the requirements in the codes?
• What are the CSST bonding requirements?
• What are the local requirements?

Lightning will damage steel pipe, copper tubing, CSST and flexible connectors.
What’s the Problem?

• Existing building/electrical codes do not require gas piping system be designed to withstand energy of a lightning strike (direct or indirect).
• Gas equipment product standards do not require any components to withstand electrical surge associated with lightning strike.
• The electrical/fuel gas code coverage for bonding of gas piping is designed to only protect consumer from harmful effects of ground faults or short circuits.
• However, metallic systems are energized by lightning despite lack of code coverage and standards.
Energizing the Gas Piping System

- Insulation failure on power circuit wiring
- Unintentional contact with higher voltage line
- Loss of the neutral on the power line
- Direct lightning strike on the structure
- Lightning strike that branches off from nearby tree, pole or other tall object
- Lightning energy conducted through the soil and underground metallic systems or through overhead power lines
- Lightning current takes all pathways of electrical resistance to ground and not just the path of "least resistance".
Lightning Induced Piping Damage

Damage is attributed to arcing caused by a difference in voltage build-up between the grounded electrical system and any other electrically conductive pathway. **Arcing damage impacts all gas piping materials.**
National Lightning Statistics

• Average number of lightning flashes/year: 25,000,000

• Average annual number of U.S. home fires* by cause:
  - Fires caused by natural gas: 5,300
  - Fires caused by lightning: 8,650
  - Fires caused by lightning/gas: 120
  - Fires caused by electric distribution: 32,000
  - Fires caused by lightning/wires: 435

* NFPA data

Lightning damage to gas piping is an uncommon event compared to other causes of fires.
Grounding verses Bonding

- A conducting connection between an electrical circuit or equipment and the earth that limits the voltage imposed upon it. Only the premise wiring system is grounded.

- The permanent joining of metallic parts to form an effective electrical path that ensures continuity and the capacity to safely conduct any current likely to be imposed. Gas piping is bonded.
Is Extra Bonding Needed?

- Gas piping is already bonded through the equipment grounding conductor.
- Any metallic system can become energized by electric currents induced by an indirect lightning strike.
- The gas piping does not fail from current flow, but from arcing (caused by a difference in voltage build-up) between other electrically conductive pathways.
- Equi-potential bonding of all metallic systems will significantly reduce the chances for arcing and/or ground-fault hazards by minimizing the difference in voltage.
Applicable Codes and Standards
NEC Bonding Requirements

250.104(B): Other Metallic Piping: Where installed in or attached to a building or structure, metal piping system(s), including gas piping, that is likely to become energized shall be bonded to the 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. 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 that is likely to energize the piping shall be permitted to serve as the bonding means.

The points of attachment of the bonding jumper(s) shall be accessible.
NFGC Bonding Requirements

• Each above ground 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 where it is connected to appliances that are connected to the equipment grounding conductor of the circuit supplying that appliance.

• Gas piping shall not be used as a grounding conductor or electrode.
Equipment Grounding Conductor

Photo 5. A gas furnace supplied by a branch circuit that has a metal gas piping system supplying it.
Proposal to 2009 NFGC

CSST gas piping systems shall be bonded to the electrical service grounding systems at the point where the gas service enters the building. The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent.
Summary Code Requirements

- Minimum requirement for bonding is satisfied if gas piping is connected to a powered appliance that is connected to a grounding conductor.
- Use of appliance grounding conductor is sufficient for personal safety in the event of an electrical fault.
- No bonding required if gas appliance is not powered such as water heater or fireplace insert.
- Bonding is independent of piping material.
- Direct bonding is a permissible alternative method, but not mandated.
Impact on CSST Piping Systems

Listed to ANSI Standard Complete Piping System
- Tubing
- Fittings
- Strike Plates

Installed in accordance with manufacturer’s instructions
Six Manufacturers: One Approach

Omegaflex - TracPipe
Ward Mfg - Wardflex
Parker - ParFlex
Titeflex - Gastite
Truflex - Pro-Flex
MetalFab - Diamondback
Technical Bulletins

Technical Bulletin: #16
Electrical Bonding and Grounding

In accordance with NFPA 70 National Electrical Code (NEC) proper bonding and grounding of gas piping systems in structures and the structure's electrical system is required by a qualified electrician. This requirement provides an effective electrically continuous path in an effort to conduct stray voltages created solely to ground. The NEC also states that it is good practice to bond all metallic systems and objects. In accordance with these requirements, WARDFLEX™ requires the gas piping system to be bonded to the electrical earth grounding system of the structure through the use of a bonding clamp and wire.

- The bonding point must be in close proximity to the electrical panel as practical, close proximity of the bonding point to the gas meter is also desirable.
- The wire gauge for this bond must be sized, at a minimum, for the full ampereage available through the electrical service.
- Further minimizing impedance over the bonding assembly is desirable. The NEC should be referenced for additional requirements and specific techniques for bonding and grounding.

For attachment to the WARDFLEX™ gas piping system, bonding clamps must be attached to the WARDFLEX™ brass fitting, to a metal manifold, or to a rigid pipe component connected to a WARDFLEX™ fitting. The corrugated stainless steel portion of the gas piping system shall not be used as the bonding attachment point under any circumstance.

The WARDFLEX™ flexible gas piping or other gas system components shall not be used as a grounding electrode or as the grounding path for application of electrical systems.

Bonding and grounding requirements are also contained in NFPA 74 National Fuel Gas Code. NFPA 54 specifically requires:

"...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."

Proper grounding and bonding 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 energized. If the systems are not properly bonded, the difference in potential between the systems may cause the charges to be transferred from one system to another. Arcing can cause damage to CNET. Bonding and grounding as set forth above should reduce the risk of arcing and related damage.

Depending upon conditions specific to the location of the structure in which the WARDFLEX™ system is being installed, including but not limited to whether or not the area is prone to lightning, the owner of the structure should consider whether or not a lightning protection system is necessary or appropriate. Lightning protection systems are beyond the scope of this bulletin, but are covered by NFPA 780 which is the Standard for the Installation of Lightning Protection Systems, and other standards.

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KISS Principle

- One simple, universal bonding approach
- Effective and low cost
- Consistent with requirements of NEC
- Applies to all single family and low-rise multi-family
- Commercial applications may require an engineered solution
CSST Manufacturer’s Instructions

• Direct bonding of CSST to the grounding system is now required
• Per the requirements of NEC 110.3(B)
• One-size-fits-all for most residential applications
• Installation and sizing requirements consistent with NEC Section 250
• Do not bond any underground piping upstream of utility meter
Direct Bond Connection

- Electrical service equipment enclosure
- Grounded conductor at the electrical service
- Grounding electrode conductor
- Grounding electrode

Figure 5. Metal water piping system bonding jumper connection
Bond Near the Gas Service

- Customer side of meter
- Downstream of 2nd stage LP regulator
- Indoors or outdoors
- Upstream of first CSST fitting
Daisy Chain for Multiple Meters

Photo 4. Listed metal water piping clamp for smaller metal water piping systems
Bonding Jumper

- 6 AWG copper wire or equivalent
- Protected in accordance with NEC 250.64
- Jacketed or bare
- Above or below grade
- Keep as short as possible
Attachment Points

Between meter and first CSST fitting

Attached to pipe or pipe component per the clamp listing

Never attach to corrugated tubing itself

Insure metal-to-metal contact between clamp and sub-surface
Bonding Clamp

- Listed to national standard
- UL 467 or UL 96A
- Attached in accordance with NEC 250.70 and listing
- Always accessible
Trade Issues

• For new installations, plumbers install piping but not bonding wire or clamps. Qualified electrical contractor must install bonding connection.
• On retrofit jobs, plumbing installer required to get qualified electrical contractor to do bonding.
• Cost for bonding ranges from $30 to $300 per house.
Conclusions

- No code or standards requirements mandating lightning resistance, protection or mitigation.
- New bonding requirements above minimum of NEC.
- Direct bonding will significantly reduce impact of lightning strikes on gas piping system without effecting ground-fault protection.
- CSST industry pro-actively requiring direct bonding on all CSST installations with a one-size-fits-all approach.
- Model and state code change proposals are being developed.
- CSST product standard being updated.
- Manufacturers providing technical support and training of installers and inspectors.
Any Questions?

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