Welcome to the 2018 Annual Conference Educational Sessions

Session: Why, When, What and Where Lightning Protection is Required
Why, When, What and Where Lightning Protection is Required

Model Codes, Standards, Listings and Instructions

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Who is Bob Torbin?

Professional Engineer
BS and MS Mechanical Engineering
Over 40 years industrial experience
Director of Codes and Standards
NFPA 54-TC and Chair-ANSI LC-1
“Lightning is a stochastic, if not capricious, natural process. Its behavior is not yet completely understood.”

NFPA Standards Council
Why, When, What and Where

What is CSST?

- National Standard ANSI LC-1
- System performance-based standard
- Listed system installed in accordance with manufacturer’s instructions and local code
- Standard recognized in all fuel gas codes
- Commercially introduced in 1990
- More than 1.2 billion feet installed
Why, When, What and Where

Applicable Certifications and Listings

• Tested and listed by CSA (NRTL) to ANSI LC-1
• Tested and listed by IAPMO R&T
• Tested and listed by ICC ES
• Tested and listed by UL for E-84
Why, When, What and Where

Advantages of CSST

- Long continuous runs
- Few joints
- Smaller installation crew
- Faster installation time
- Only simple hand tools required
- No threading machines/mess
- Safer interaction with structure
Why Lightning is a Problem

Total lightning strokes in US per year: 20-40,000,000*

Regional issue

No house, equipment or material safe from direct lightning strike

[*USPLN: 2005-2009]
Why, When, What and Where
Lightning Pathways
Why, When, What and Where
Why, When, What and Where

Residential House Fire Statistics

Average annual number of U.S. home fires by cause*:
- 1 & 2 family house fires: 358,000
- Fires caused by electric distribution: 31,960
- Fires caused by fuel gas: 9,040 (2,440 leaks & breaks)
- Fires caused by lightning: 4,300
  - Fires caused by lightning/wires: 380
  - Fires caused by lightning/fuel gas: 210

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

[* 2010-2014 NFPA Statistical Data]
Why, When, What and Where

Reality Check: Lightning Damage

• Less than 100 lightning CSST fires per year and declining

• CSST lightning fires are less than 0.05% of total house fires

• CSST lightning fires are less than 1% of all gas fires

• 75% of lightning damage: yellow CSST not bonded

• Over 200,000 insurance claims per year for lightning damage

CSST does not represent a clear and present danger to consumers.
Why, When, What and Where

Lightning does not discriminate. It seeks all pathways to ground.

Arcing damage impacts all metallic systems including wiring and all gas piping materials.
Why, When, What and Where

Why Bonding Works

Damage not due to lightning induced voltage levels, but due to large differential in voltage potential.
When Did Things Change

Changes in Construction

No residential sprinklers
Lightweight engineered wood products
Large homes wood frame construction
Southeastern/western demographics
Former farm fields
Why, When, What and Where

Changes in Plumbing/Fuel Gas

Loss of metal piping

- Vents/drains
- Water
- Fuel gas
Why, When, What and Where

Changes in Electrical

- Replacement of metallic conduit for electric power cable (such as MC or EMT) with NMS (romex) wiring.
- Dielectric strength of wire insulation can breakdown under lightning stress and cause arcing.
- Alternative communications
Why, When, What and Where

Changes in Mechanical

Metallic appliance flue (in stead of brick/clay chimneys) which rise above the roofline. Metal vent acts like lightning rod not directly connected to the electrical grounding system.
What are the Code Requirements

Codes and Standards

- National Electrical Code (NFPA 70)
- National Fuel Gas Code (NFPA 54)
- International Fuel Gas Code
- Lightning Protection Std. (NFPA 780)
- ANSI Standards

- 50 State Fuel Gas Codes

No requirements for lightning protection
Why, When, What and Where

Product Standards

- National consensus standards
- No requirements for lightning resistance or certification
- No prescribed national test method for lightning resistance
- For both mechanical and electrical equipment
Why, When, What and Where

NFPA 780: Lightning Protection System

- Lightning protection not mandated
- Designed to protect the structure but not a 100% guarantee
- Active and passive protection
- LPS require equi-potential bonding of all metallic systems
- Bond all gas piping (6 AWG)
Bonding of Piping Systems

(B) Other Metal Piping. If 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 any of the following: equipment grounding conductor for the circuit that is likely to energize the piping system; service equipment enclosure; grounded conductor at the service; grounding electrode conductor if of sufficient size; or one or more grounding electrodes used. The bonding conductor(s) or 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 points of attachment of the bonding jumper(s) shall be accessible.
Why, When, What and Where

NEC- Ground Fault Protection

EGC sized to protect against ground faults

Bonding wire sized based on size of branch circuit

12 AWG wire not designed to handle large DC voltage associated with lightning
Why, When, What and Where

Manufacturer’s Bonding Requirements (2006)

Downstream of point of delivery
Single point of attachment required
Bonding clamp on pipe/fitting
Conductor at least 6 AWG copper
Conductor as short as practical
Connect to grounding electrode system
CSST. CSST gas piping systems shall be bonded to the electrical service grounding electrode system. The bonding jumper shall connect to a metallic pipe or fitting between the point of delivery and the first downstream CSST fitting. The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent. Gas piping systems that contain one or more segments of CSST shall be bonded in accordance with this section.  

* Informational Note in 2011 NEC
Why, When, What and Where

Bonding Effectiveness Research

Phase I: State-of-the-Art Review: SEFTIM

Phase II: Testing Program
- Parametric testing of CSST
- Computer simulations
- System testing/verification
- Final predictive simulations

Phase III: Publish Results
Why, When, What and Where

2015 IFGC Requirements

- Bonding is required for all CSST
- Clamp located anywhere
- Single point of attachment
- Conductor of 75-ft or less
- Required for new and retrofit
- Bond all grounding electrodes
Where is Bonding Performed

Bonding Gas Systems After “Point of Delivery”

* Bonding Clamps listed to UL 467
Why, When, What and Where
Bonding Gas Systems After “Point of Delivery”
Why, When, What and Where

Bonding Clamp* Attachment

* Clamps listed for CSST fittings
Why, When, What and Where

Bonding Clamp Attachment
Why, When, What and Where

Bonding Clamp Attachment

Never place bonding clamp directly on CSST tubing or jacket
Gas piping systems that contain one or more segments of CSST shall be bonded.
Why, When, What and Where

Bonding Connections
Why, When, What and Where

Bond Connection to Grounding System
Why, When, What and Where
Bond to Intersystem Bonding Terminal?

An external accessible intersystem bonding termination must be provided at service or metering equipment, and at the disconnecting means for a building or structures supplied by a feeder.
Why, When, What and Where

Bonding Requirements
Why, When, What and Where

Bonding Conductor Sizing

- Conductor at least 6 AWG copper or 4 AWG aluminum
- Conductor single or multi-strand
- Conductor length less than 75-ft
- Shorter is better
Why, When, What and Where

Bonding Effectiveness Factors

- Lightning entry point
- Equi-potential bonding
- Bonding location
- Length of conductor
- Proximity of other pathways
- Grounding electrode system
Why, When, What and Where

Technical Innovation - Arc-resistant CSST
Why, When, What and Where

Arc-resistant Protective Jacket*

[* No product is immune from lightning damage.]
Why, When, What and Where

CSST Listing Criteria (2010/2011)

- Establish minimum arc-resistance
- 4 arc-resistant CSST available
  - CounterStrike/OmegaFlex
  - Wardflex Max/Ward
  - FlashShield/Gastite
  - Flak Jacket/ProFlex
- Show bonding equivalency
Why, When, What and Where

ANSI LC-1-2014 CSST Standard

- Both yellow and black CSST
- Electrical arcing testing: 4.5 C
- Jacket wear/ripping testing
- Cold temperature tolerance
- Corrosion evaluation on metallic parts
- All current black CSST certified
Why, When, What and Where

2018 IFGC/IRC Code

Yellow CSST
• Bonding required
• Conductor of 75-ft or less

Black CSST
• Bonding not required
• CSST listed per ANSI LC-1-2014
310.2 CSST. CSST gas piping systems and piping systems containing one or more segments of CSST (not listed with an arc resistant jacket or coating system in accordance with ANSI LC-1) shall be electrically continuous and bonded to the electrical service grounding electrode system or, where provided, the lightning protection grounding electrode system. (and shall comply with Sections 310.2.1 through 310.2.5.)

310.2.1 Point of connection
310.2.2 Size and material of jumper
310.2.3 Bonding jumper length
310.2.4 Bonding connections
310.2.5 Connection devices
310.3 Arc-resistant CSST. Corrugated Stainless steel tubing that is listed with an arc resistant jacket or coating system in accordance with ANSI LC-1 shall comply with this section. The CSST shall be electrically continuous and bonded to an effective ground-fault current path. Arc-resistant-jacketed CSST shall be considered to be bonded where it is connected to an appliance that is connected to the appliance grounding conductor of the circuit that supplies that appliance.

Where any CSST component of a piping system that does not have an arc resistant jacket or coating system, the bonding requirements of Section 310.2 shall apply.
Why, When, What and Where

Installing Arc-Resistant CSST
Why, When, What and Where

Different Listing Criteria

ICC ES LC-1024

ICC ES LC-1027
Gas piping shall not be used as a grounding conductor or electrode.

Bonding clamp always on customer side of the meter.

Only one grounding system for the house.
Why, When, What and Where

Ground Connection of Grounding Electrode(s)

Earth resistance reading at ground rod must be less than 25 Ohms or a second driven rod must be installed.

Earth resistance can vary based on soil type, season and type of electrode.
Why, When, What and Where

Protect CSST & Conductor From Physical Damage
Why, When, What and Where

Good News and Bad News
Why, When, What and Where

Avoid Direct Contact with Metallic Systems
Where Do We Go From Here

Inspector Training/Education/Code Change
Why, When, What and Where

ICC CodeNotes (2015 and 2018)
Why, When, What and Where

What About Legacy Homes?

www.CSSTSafety.com
Questions and Answers?

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Thank You For Attending